Department of Agriculture and Marketing

1985 RESEARCH REPORT

RESEARCH COMMITTEE - 1985

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1985 Statistical Summary

Research Projects were funded from a number of sources. Some of these were at the discretion of the Committee while others were the result of individual initiative. A number of investigative projects are not included. The fund sources are as follows and may or may not be included in these statistics.

Source	Projects/ Grants	Funds $,000.
N. S. Department of Agriculture and Marketing	53	301,
Agriculture Canada	5	53,
NSERC	12	220,
Industry Contracts and Grants	12	64,
Canada-Province Development Agreement	14	239,
	96	877,

Readers are encouraged to contact the project leaders for further information. Inquiries concerning the overall program may be made through any committee member.

1985 RESEARCH PROJECT REPORTS

Project Number	Project Leader	Project Title
85-06	J. S. Bubar	Cereal and Protein Trials
85-07	J. S. Bubar	Forage Crops Evaluation
85-10	J. Fraser	White Clover Evaluation
85-12	C. Caldwell	Max Spring Wheat
85-15	D. L. Patterson	Beef Cow Conditions
85-16	M. L. Connor	Fox Production
85-17	J. Adams	Sheep Shelter
85-18	D. Mellish	Winter Wheat
85-19	N. Rifai	Carrot Harvester
85-20	G. Sampson	Weed Survey
85-23	D. M. Anderson	Canola Seed in Broiler Rations
85-24	T. H. Haliburton	Vegetable Trials
85-25	R. Prange	Ostrich Fern
85-26	L. Eaton	Nutrition in Blueberries
85-29	P. Warman	Nutrients - Blueberries
85-30	H.-Y. Ju	Ginseng
85-31	K. MacLean	Arsenic
85-32	G. Stratton	Pesticides
85-38	H. M. MacConnell	Analytical Methods - Poultry Feeds
85-39	P. Dzikowski	Blueberry Production Study
85-40	P. Dzikowski	Blueberry Data Base
85-42	H.-Y. Ju	Micronutrients - Blueberries
85-45	D. M. Anderson	Digestibility - Atlantic Feedstuffs
85-46	R. Daniels	Turfgrass

85-50	F. Desir N. Rifai	Orchard Mower
85-51	D. C. Crober	Computerized Environmental Control
85-52	G. Sampson	Quackgrass
85-53	B. Gray	Winter Wheat and Barley Diseases
85-57	D. M. Anderson	Diets for Swine
85-65	R. Robinson	Ferulic Acid
85-66	R. Robinson	Heat Detection
85-67	R. Robinson	Corticosterone - Layers
85-68	J. P. LeBlanc	Predatory Mites on Apples
85-69	R. Olson	Test Tube Pollination Potatoes
85-70	J. Nowak	Germplasm Preservation
85-71	G. Stratton	Pesticide Toxicity Data
85-72	P. Warman	Plant Cover on Soils
85-73	P. Warman	Asparagus
85-74	H.-Y. Ju	PGR on Blueberry
85-75	G. Miller	Radioassay
85-76	T. Tennessen	Dairy Cow Husbandry
85-77	T. Tennessen	Cage Design
85-78	A. Madani	Reference Crop ET
85-80	A. H. Fredeen	Milk Fever
85-81	G. Grant	Feed Grain Sources
85-82	Y. Surry	Analyzing Pricing Efficiency in Canadian Table Potato Markets
85-83	D. L. Patterson	Carcass Growth and Quality
85-84	D. M. Anderson	Fox Production (Dry-Wet Feeds)
85-85	D. Allen	Heat Reclaimer Study
85-86	D. C. Crober	Antibody Production of Layers

85-87	M. L. Connor	Hormone Assays
85-88	J. P. LeBlanc	Arthropods - Blueberries

Project 85-06

TITLE: Cereal and Protein Crops

LEADER: J. S. Bubar

OBJECTIVE: To support the breeding programs aimed at developing grain crops for the Atlantic Region. To evaluate cultivars for recommendation and licensing. To support other research and development projects by carrying out other small plot trials that are requested by Atlantic Advisory committee members.

PROGRESS:

Details on our evaluation trials are included in various regional data compilations and in the annual Plant Science Department report on evaluation trials.

Our 1985 spring seeded cereal trials were the best we have had since the regional evaluation trials were established. We had high yields, good uniformity and low coefficients of variability that gave very good discrimination between entries in these trials. The top yielding entries exceeded 7000 kg/ha in several of these trials.

Winter cereal trials sustained fairly severe winter damage, which serves to give us confidence that the best performing entries are the best available for reliability in our region. Winter triticale entries are promising as reasonably hardy and high yielding winter cereal crops.

Regional soybean and pea trials are in good agreement with other trials in the region although the actual yields of soybeans were below the average, which we blame on problems with weed control.

Cereal crop evaluators meeting at Charlottetown on January 29 and 30, 1986 expressed concern with the problems of getting enough station-years of data to support the registration of cereal cultivars suited to the Atlantic Region. The data from the Truro trials matches that from the best Agriculture Canada research sites and is considered essential to the regional program. The evaluators are concerned that we continue all trials that were conducted in the past year.

Project 85-07

TITLE: Forage Crops

LEADER: J. S. Bubar

OBJECTIVE: Evaluation as required by the Advisory Committee on Forage Crops to meet needs for crop recommendation and for registration of new cultivars.

PROGRESS:

The amount of material entering our regional forage evaluation trials for the established forage crops has been declining. Evaluation of new forages is being carried out, at least on a short-term basis, using regional agricultural development funds. This is permitting us to be less dependent on the Nova Scotia Department of Agriculture and Marketing support for short-term development projects. However, we do require some secure long-term funding to keep the evaluation system viable for the whole Atlantic region. The support given to this work at N. S. A. C. by the N. S. Dept. of Agr. & Mktg. indicate a commitment to regional evaluation that appears to help maintain some support for evaluation in the "A-base" budget of other co-operators.

A major achievement in our co-operative program to which our N. S. A. C. program contributed heavily is the improved cultivars of red clover that are becoming available. We are now seeking registration of cultivars that have out-yielded the best currently available cultivars by more than 10% in pure stands in our regional trial average.

New fescue x ryegrass hybrids are also promising as higher quality alternatives to Kenhy.

New regional trials of alfalfa, red clover and fescue x ryegrass hybrids are to be established in 1986.

Concurrently, I will continue work on evaluation technique supported by the AFDA contract.

Project 85-10

TITLE: Evaluation of white clover/grass mixtures for pasture.

LEADER: Joanna Fraser

OBJECTIVES:

1. Determine which pasture grass species would give the highest dry matter yields with white clover.

2. Assess protein quality in white clover/grass mixtures.

PROGRESS:

A field experiment was seeded May, 1984 using 4 cultivars of white clover: Ladino (control), Pitau, Sonja and Kent. These were seeded in monoculture or in combination with either Frode orchardgrass, Kenhy tall fescue or Birka bluegrass at Plumdale Farm, N. S. A. C. The experiment was divided into two sections; 1A and 1B referring to plots cut twice and once in 1984 respectively. In 1985, five cuts were taken from all plots in both sections. Fertilizers were applied after each cut.

In 1985, Sonja initially out-yielded the control cultivar Ladino by 18% in Experiment 1A, and Kent initially out-yielded the control cultivar by 12% in Experiment 1B. In subsequent cuts on 1B, Ladino out-yielded all other cultivars irrespective of grass combination, whereas in 1A, Pitau was the highest yielding white clover. Dry matter yields were highest in mixtures containing orchardgrass or tall fescue in both experiments. White clover/bluegrass mixtures were significantly lower than those with orchardgrass and tall fescue, but out-yielded clover monocultures in late season. Total clover/grass D. M. yields were in the order of: orchardgrass > tall fescue > bluegrass > clover monoculture.

Protein yields in the first three cuts were high in both experiments irrespective of treatment, but declined in cuts 4 and 5 due to lower D. M. yields. Sonja had the highest cumulative total protein yields of all white clovers (1610 kg/ha), whereas the highest cumulative protein yields came from bluegrass/white clover mixtures (1616 kg/ha).

These preliminary results indicate that: a) white clover has excellent regrowth following cutting; b) total D. M. yields in white clover/grass mixtures are similar to results with white clover/perennial ryegrass mixtures in Scotland; c) white clover is compatible with recommended pasture species; d) two cuts of white clover are possible in the establishment year without adversely affecting winter survival and e) protein levels are maintained within a reasonably constant range and total protein yields (5 cuts) are higher than other legume species used in this region.

Project 85-12

TITLE: Evaluation of Max Spring Wheat under Intensive Management.

LEADER: C. D. Caldwell

OBJECTIVE: To evaluate the response of Max spring wheat to intensive management in terms of yield, protein content and milling quality.

PROGRESS:

1) Interaction of Fertility and Plant Growth Regulators.

The effects of Cerone, Cycocel and no PGR were tested at three levels of nitrogen. The fertility and PGR type treatments did not interact to affect any of the measured parameters. Nitrogen tended to increase disease but also increased grain yield and grain protein. T. K. Wt. was depressed by increasing nitrogen. It is noteworthy that while the increase of 50 to 100 kg N/ha did not produce a large yield increase, it did produce grain protein level which would make it acceptable for milling. Max wheat seems to be particularly sensitive to Cycocel; 920 gai/ha at ZGS31 produced a 20 cm decrease in height. The cycocel also decreased T. K. Wt. without depressing yield. Cerone decreased plant height but had no other significant effects.

2) Fertility x PGR x Fungicide

The effects of the presence or absence of Cerone and/or Tilt were tested at three levels of nitrogen. Only a couple of two-way interactions occurred. Increasing nitrogen increased powdery mildew but seemed to decrease leaf septoria incidence. Plant height, head septoria and rust on the flag leaf were increased by the nitrogen application. Grain yield and grain protein were increased by the N but the latter not sufficiently to produce milling quality. Cerone decreased plant height but lodging was not a problem in this trial. Tilt decreased rust, septoria and mildew on the flag leaf and resulted in a higher grain yield and T. K. Wt. at a lower moisture at harvest.

3) PGR x Tilt

The effects of no PGR, Cerone, Cycocel or Terpal C were tested alone or in combination with Tilt fungicide applied at ZGS32, 45 or at both 32 and 45. PGR did not interact with fungicide to affect any parameters in this trial. Max was particularly sensitive to Cycocel and Terpal C with height reductions of about 20 cm; Cerone produced more than 10 cm of height reduction. Cycocel induced higher levels of flag leaf rust and septoria and depressed T. K. Wt. Terpal C depressed yields in comparison to theCerone treatment, partially due to a lower T. K. Wt. The early application (ZGS32) of Tilt was more effective than the late application (ZGS45) for control of mildew, leaf septoria and head septoria. The later Tilt had better control of head mildew, glad leaf rust, flag leaf septoria and powdery

mildew. The two applications of Tilt were best only for flag leaf septoria and flag leaf powdery mildew. Highest grain yield was found with the two applications of Tilt, partially due to an elevated T. K. Wt.

The grain samples produced from these trials in 1984 and 1985 have been analyzed for milling quality at CDA Kentville. This milling data was used to support licensing of Max wheat which occurred in early 1986.

Project 85-15

TITLE: Effect of Beef Cow Condition on Production

LEADER: D. L. Patterson

OBJECTIVE: To determine the effect of breed of cow on condition and size and on subsequent calf performance.

PROGRESS:

Data were collected from 90 cows from the N. S. A. C. beef herd during the period from May, 1984 to October, 1985. At that time the herd consisted of 20 purebred Hereford cows (HE), 29 purebred Shorthorns (NSAC-SH), 8 purebred Shorthorns of the Lacombe Control Strain (CL-SH), 27 purebred Shorthorns of the Lacombe Select Strain (SL-SH), and 6 Hereford-Shorthorn cross cows. The Lacombe strains were obtained from the Agriculture Canada Research Station at Lacombe, Alberta, in February, 1984, where the Select Strain had been under selection for increased yearling weight since 1960.

There was a significant difference between breeds for cow weight, hip height, and condition score in May of 1984 but not in 1985. CL-SH cows were smaller and in poorer condition than the other groups. (Condition score was measured on a five point scale, with 1 being emaciated and 5 extremely fat.) However, these breed differences are confounded with age differences. Seven of the eight CL-SH and 20 of the 27 SL-SH were six years of age or greater, while the other two breed groups had a more even distribution of ages.

There was a significant effect of breed on calf birth weight and ROP adjusted weaning weight in 1984, but again not in 1985. NSAC-SH cows had larger calves. However, these calves were primarily sired by a Simmental bull while CL-SH cows and SL-SH cows had been bred to a bull of the same strain. Calves with heavier birth weights had a higher average daily gain to weaning and a heavier adjusted weaning weight in both 1984 and 1985 in the NSAC-SH. This trend was not as evident in the Lacombe breed groups.

Of cows confirmed pregnant, there was a 12.6% loss of calves to weaning time (including stillbirths) in 1984 and 7.9% in 1985. The higher loss in 1984 can be attributed in part to three cases of dystocia resulting in calf death in Simmental-sired calves and perhaps to the transport of the Lacombe cows from Alberta resulting in increased stress.

There was no significant correlation between condition score of the cow measured in January, 1985 and the 1985 calf birth weight, or between January cow hair depth or skin thickness and calf birth weight. Both cow hair depth and skin thickness

contribute to the insulating value and presumably better allow the cow to withstand severe weather. However, there was relatively little difference between breeds for these traits. Average hair depth in January was 2.7 cm for the NSAC-SH, 2.8 cm for SL-SH, and 2.5 cm for CL-SH, with the corresponding skin thicknesses being 0.7 cm, 0.7 cm and 0.8 cm. However, within each breed group, condition score of the cow in January, 1985 was positively correlated to her condition score in May and October of that year, indicating that cows in good condition at one time of the year tend to maintain that condition.

Project 85-16

TITLE: Fox Production

LEADER: M. L. Connor

OBJECTIVES:

1. To facilitate investigations into fox production and reproduction by contributing to maintenance of foxes at the N. S. A. C. Fur Unit.

2. To develop experience in artificial insemination (A. I.) techniques for foxes.

3. To compare reproductive performance of naturally vs artificially inseminated vixens.

4. To monitor changes in semen characteristics and freezability during the breeding season.

PROGRESS:

Behaviour and nutrition trials were conducted with pups born in 1985. Data has been collected on performance and manageability of foxes handled frequently as young pups and those handled more conventionally. Mature pups and adults were used for semen collection and freezing trials, AI and for student projects.

Several vixens induced into estrus, were used to gain experience with and refine the insemination technique. At the naturally occurring estrus, six vixens were artificially inseminated. Due to irregularities of estrus and unforseen complications the goal of inseminating at least ten vixens by AI was not realized. This year is providing the ground work and experience upon which to build further studies and formulate recommendations. Data will be compiled and analyzed at the end of the whelping season.

Semen was collected from ten adult and pup male foxes. Twice weekly semen sampling and evaluation were done from early February through early April. Selected samples were processed and frozen. Subsequent evaluation of post thaw viability has begun and will continue throughout the year. A student project relating testicular measurements to sperm output throughout the breeding season demonstrated a strong positive correlation between testes width and later sperm production in mid-January only. Sample sizes were not large enough to be conclusive.

Project 85-17

TITLE: Sheep Shelter

LEADER: J. Adams

OBJECTIVE: To design, construct and test a circular open roofed shelter for sheep.

PROGRESS:

Following snow flume tests on models it was decided to concentrate on a circular shelter with a partial roof and collar around the perimeter.

Investigation was carried out on the use of existing available building designs such as circular grain bins both wooden and metal. It was concluded that these could not be economically adapted for the proposed shelter. Attention was then given to structures which could be built by farmers from basic materials such as wood and plywood. Consideration was given to developing a modular unit which would combine wall and roof. Angular framed sections were investigated but the required bracing resulted in too many internal obstructions, and so curved sections were considered. Bending wood is possible but requires care and suitable clear wood, knots or flaws in the wood tend to cause breakages. A curved modular unit was therefore developed using wood and plywood which required only the plywood to be bent. The aim was to use simple construction and standard available materials.

In designing the circular shelter 12 units are combined to form a duodecagon, 26 feet (7.8 m) in diameter. The units are set at an angle of 45^{o} to the horizontal which results in a height and cover of 5 foot 6 inches (1.67 m). The resulting roof opening is 15 feet (4.5 m) in diameter. To complete the walls triangular pieces of plywood are placed over the spaces between the modular units. A plywood collar is fixed around the open roof and access doors cut in one or two modular units.

The total floor area of the shelter is 530 square feet (47.8 m^2), the effective floor area taken as 18" in from the perimeter is 415 square feet (373.4 m^2) and the area of the open roof is 176 square feet (15.90 m^2).

Twelve units were constructed to form a shelter and transported to a farm in Scotsburn where they were erected in a field. This shelter was used to hold feeder lambs over the winter with the lambs having free access to the field and shelter. Feed was provided outside of the shelter and water was available from a stream. The flock consisted to 50 lambs with this number later reduced to 22. The farmer considered the arrangement could accommodate 70. The exceptional snowfall tested the structure, some snow accumulated inside the centre of the building and built

up outside but the sheep lay around the inside perimeter of the buidling. The farmer considered the building suitable as a shelter. The sheep used the shelter without any persuasion or encouragement and the farmer considered the shelter suitable for his purpose. The unexpected large amount of snow which fell built up on the outside of the buildings. It was observed that the structure required stronger fixtures and supports at the roof opening.

Project 85-18

TITLE: Winter Wheat Production Management

LEADER: D. R. Mellish

OBJECTIVE: A) To evaluate response of a potential milling quality winter wheat to a range of nitrogen rates and timings and the possible interaction with a plant growth regulator.

B) To evaluate the response of several winter wheat cultivars to four management regimes to determine if cultivar/management interaction exists.

PROGRESS:

A) Nitrogen Timing and Rates

Seasonal rates of 150, 200 and 250 kg/ha^{-1} of nitrogen was applied to absolvent winter wheat in six timing combinations. These treatments were superimposed over an area treated with the plant growth regulator (PGR) Cycocel Extra and an area receiving no PGR.

Foliar fungicides were used to control disease, however, due to excessively heavy disease pressure control was less than desirable.

The timing of the nitrogen application did not significantly affect any agronomic character.

On this highly fertile soil, following a red clover plough down the 250 kg/ha^{-1} rate did promote lodging and a reduction in yield. The 150 kg/ha^{-1} was adequate to accomplish the 13.5% grain protein level required to meet milling standards.

Yield levels were low due to excessive precipitation and thus clear conclusions cannot be drawn from the experiment.

B) Cultivar/Management Response

The performance of all winter wheat cultivars were evaluated under four management systems. The effect response of a cultivar to additional nitrogen applications, disease control and a PGR was evaluated.

Planting was delayed beyond the optimum seeding date due to late arrival of seed.

Winter kill was significant with the weakest cultivar having a 38% survival compared to 97% for the strongest.

The PGR shortened the crop (10 cm) and the disease control gave a modest yield increase.

Due to the significant winter kill and heavy disease pressure not completely controlled by the fungicide, yields were low.

This trial was pivotal in identifying potential difficulties in conducting such a trial. A similar type trial is now being conducted at multiple sites in the Maritimes co-ordinated by the Advisory Committee on Cereal and Protein Crops and funded by the New Crop Development Fund.

Project 85-19

TITLE: FMC Carrot Harvester Modifications

LEADER: M. N. Rifai and F. Desir

OBJECTIVE: To modify FMC carrot harvester by using sensors to replace the operator controls.

PROGRESS:

The FMC harvester was found to be highly efficient when operated skillfully, provided crop and soil conditions were good. Under such conditions, losses were found to be in the order of one percent of marketable product. Given proper crops and soil conditions, the biggest constraint to such high performance is the skill and alertness of the operator. During the harvesting operation, he operates two controls to keep the gathering points aligned laterally with the row, and at the correct height. This requires skill and continuous concentration, which is difficult to maintain for extended periods.

The prototype has been developed and consists of two automatic devices, one to control the depth by floating the gathering points on a wheel, the other to keep the gathering points aligned with the crop row by means of feelers.

We will try this coming fall to test the FMC harvester with the new prototype in order to determine the harvesting losses, and how well the two automatic devices will perform.

Project 85-20

TITLE: Weed Survey of Nova Scotia Blueberry Fields

LEADER: M. G. Sampson

OBJECTIVE:

1. To conduct a survey of blueberry fields in central and northern Nova Scotia to determine what the most common weeds are in Nova Scotia blueberry fields.

2. To collect, identify and demonstrate, through pictures, herbarium specimens and a weed garden, at the Nova Scotia Blueberry Institute, the weeds common to lowbush blueberry fields of Nova Scotia.

3. To evaluate experimental herbicides for control of Cornus canadensis L.

PROGRESS:

1. Weed Survey

Seventy blueberry fields in central and northern Nova Scotia were surveyed for weeds. Weed density and species composition were recorded in 20 one-meter square quadrats randomly placed along transects in each field.

The weeds found to have the highest frequency and densities included Cornus canadensis L. (bunchberry), Rumex acetosella L. (sheep sorrel), Mianthemum canadense Desf. (wild lily of the valley), Potentilla simplex L. (5-finger cinquefoil), Viola spp. (violets), Danthonia spicata (L.) Beauv. (poverty oatgrass). In addition, 94 other species were recorded at various frequencies.

Some weeds are reason for concern because they may be on the increase. These include barrenberry, huckleberry, trailing blackberry, honeysuckle and loosestrife. All of these are tolerant or resistant to the herbicide hexazinone (Velpar™) and continued use may lead to increased problems with these weeds.

2. Weed Identification

The identification portion of the research has been directed at three areas. First, a weed garden, containing common blueberry weeds has been established at the Blueberry Institute, Debert, N. S. and is available for viewing during the summer. Second, pressed specimens and photographic slides are available for teaching and extension work in the Weed Research Laboratory, Cox Institute, Nova Scotia Agricultural College. The third area involves the publication of a booklet on common blueberry weeds. Completion of this booklet is dependent upon receiving financial support. The booklet will contain color pictures, botanical

sketches and written descriptions of about 40 common weeds. It is hoped that this booklet can be completed by January 1987.

3. Chemical Weed Control

Screening trials were established in the spring and autumn of 1985 to evaluate several experimental herbicides for control of hexazinone-tolerant weeds. The benefit of finding such a chemical and registering it, would be providing a control for these difficult to control weeds for which there is currently no control. This project involves the graduate work of Mr. Kevin McCully, who is currently conducting his Masters at Macdonald College of McGill University.

Although several herbicides effectively controlled bunchberry, there was unacceptable injury on the blueberries. There were indications that lower rates of some of these herbicides may control bunchberry but not significantly damage blueberry.

FUTURE PROGRAM:

1. Complete booklet on identification of blueberry weeds.

2. Maintain the plants in the weed garden at the Blueberry Institute.

3. Continue to evaluate experimental herbicides for control of hexazinone-tolerant weeds.

Project 85-23

TITLE: Evaluation of Full Fat Canola Seed in Broiler Diets

LEADER: D. M. Anderson

OBJECTIVE: To evaluate Nova Scotia grown whole canola seed in starter and grower diets of broiler chickens.

To compare the feeding value of raw and cooked canola seed in broiler diets.

To determine the optimum level of whole canola seed in corn based diets for broiler chickens.

PROGRESS:

During 1984 three flocks of birds were used to determine the value of full fat canola seed in diets for broiler chickens. Comparisons were made comparing raw versus cooked canola seed. Canola seed was introduced to the diet of birds at hatch, week 1 and week 2 to determine the most optimum time to introduce canola seed. Nova Scotia grown canola seed was compared to Western Canadian grown canola seed in starter diets for birds from 0 - 4 weeks and in finisher diets for birds from 4 - 7 weeks.

The final stages of preparation of this material for publication will begin shortly. The data will be reported to demonstrate the effect of cooking and the comparison of time of introduction of full fat Canola seed to the diets of broiler chickens.

Project 85-24

TITLE: Vegetable variety/management trials

LEADER: T. H. Haliburton

OBJECTIVE: To further study factors affecting single-heartedness and bolting of sweet Spanish onions, e.g. cultivars, spacing, use of sets, containerization, age relationships, temperature at critical periods. Spanish onion imports exceed three million pounds for processing and fresh use, and are increasing.

PROGRESS:

Multiple-transplant-unit Production of Spanish Onions

Sweet Spanish onions cv. Fiesta were seeded in 25 x 50 cm plastic trays containing 128 "cells" or individual containers on 20-3-85. They were later thinned to 1, 2, 3, or 4 seedlings per 9.2 cm^2 cell, and were transplanted to the field on May 16, 1985.

Cell groups were spaced at 12.5 or 25.0 cm in single row 7 m plots spaced 60 cm apart in a triplicated randomized complete block design.

All plots were harvested on September 4, 1985 and placed to dry in a plastic greenhouse. Numbers and weights of bolted and non-bolted bulbs in four size ranges (<30 mm, 30 to 45 mm, 45 to 75 mm, >75 mm) were recorded. After cutting horizontally, weights and numbers of bulbs with single, double, and triple or more centers were determined.

Results were analyzed by treatment (number per unit x spacing between units) and by plant populations (number of plants per meter of row). The effect of plant density by both methods was highly significant for both yield and number of single centers at all three marketable sizes.

Results suggest that a yield of onions in the medium and large sizes is greatest at a spacing about 16 plants per meter. However, since only large sized bulbs of Spanish onions are acceptable for most purposes, the most desirable spacing would be closely spaced single plants or doubles at slightly wider spacing.

The proportion of bulbs with single centers was greater with smaller sizes (essentially no multiple centers), and increased with plant density. Weight of single centered bulbs was more closely related to spacing than was yield. The percentage single centers for small, medium and large size bulbs was 90%, 63%, 37% respectively.

CONCLUSIONS:

The potential for increased production efficiency of sweet Spanish type onions appears to have limited potential. Planting two onions per site was reasonably successful, but single plants at closer spacing produced a higher yield of larger bulbs.

Bolting was not associated with spacing or with single centers in this trial, but proportions of both seed stalk and multiple centers decreases with size.

Multiple-transplant-unit Production of Cooking Onions

Onion cvs Norstar and Autumn Spice were seeded in 25 x 50 cm plastic trays divided into 128 cells on March 20, 1985. They were later thinned to 1,3,5, or 7 seedlings in each cell. They were transplanted to the field on 16 and 17 May, 1985 at 15 cm spacing in 7 m long single row plots 60 cm apart in a randomized complete block design with four replications.

Bulbs were harvested August 26, 1985 and number, weight, size, bolters, maturity, and multiple centers recorded. Size ranges were very small (<30 mm), small (30 to 45 mm), medium (45 to 75 mm) and large (>75 mm). The last two are considered marketable sizes.

Maturity and total yield increased significantly with increasing plant density. Size was inversely affected by spacing. Total yield did not increase beyond 5 plants per site, but at 7 plants average size and weight of undersize bulbs was unacceptable.

Norstar was more mature than Augumn Space (81% vs 46% down) and yield was higher at all spacings.

Comparison of the Performance of Norstar and Autumn Spice Onions (yield in grams per 5m row

No. per group	Norstar	Autumn Spice
1	10381	8708
3	13421	11798
5	17741	14260
7	16821	13647
Total	58364	48413

Bolting was highly variable and could not be attributed to spacing or cultivar. These results suggest that increased yields of marketable size cooking onions of greater maturity can be produced at lower cost by growing the seedlings in groups in transplanting cells or in soil blocks. The exact number, variety, spacing, and timing of operations require further investigation.

Project 85-25

TITLE: Clonal selection and propagation of the ostrich fern

LEADER: R. K. Prange and D. Theakston

OBJECTIVE:

1. To observe the performance of selected ostrich fern populations in a field nursery.
2. To evaluate the foliage mineral content of both young fiddleheads and mature fronds.
3. To evaluate the effect to the plant of harvesting young fiddleheads in the spring.

PROGRESS:

1. Performance of nursery populations at Brookside

1985 marked the fourth year of evaluation of the 91 populations of ferns in 1 x 2 m plots at the Ostrich Fern Nursery at Brookside. Several trends have become evident during this time. The average soil temperature during emergence of the young fiddleheads in the spring increased for the first three years and decreased slightly during the fourth year indicating a peaking and then levelling off of soil temperatures during emergence. The average soil temperature during emergence in the spring of 1985 was 12.7°C. The average date of emergence has been delayed by 8.5 days over the first year until soil temperature is conducive to frond emergence. The delay in emergence has also helped the plants avoid late spring frosts. There has been an increase in the number of living plants, from an average of 9.4 per population in 1982 to 27.5 in 1985. The dense population in most plots is aiding in preventing lodging as well as providing a good canopy for daughter plants. Harvest oven-dry weight has increased over the four years paralleling the increase in the number of living plants. The percent survival of the originally transplanted plants has shown a general decrease on average for the 91 populations. Rankings of harvest data parameters have indicated the superiority of certain populations.

2. Foliage mineral content

Foliage mineral analysis on harvested vegetative mature fronds from the Brookside Nursery has revealed a steady decline in percent N over the four years and an increase in percent P. K and Ca, with a peak in the third year. Fertile mature fronds were consistently higher in percent N and P as well as ppm Cu and Zn, but lower in percent K and Ca, ppm B, Fe and Mn, than the vegetative mature fronds. Analysis of young fiddleheads revealed higher levels of N, P. K, Cu and Zn, but lower levels of Ca, Mn and Fe, than the vegetative mature fronds.

3. Effect of harvesting young fiddleheads

Eighteen of the Brookside Nursery populations were chosen for a picking versus non-picking experiment in order to gauge the effect of crozier removal on the plant. Each populations was randomly divided in half and three croziers per plant were removed from the half chosen for picking. Oven-dry weight data on the vegetative mature fronds harvested in the fall revealed no effect to the plant due to crozier removal in the spring.

FUTURE PROGRAM:

Continued observations and evaluation of the Brookside Nursery populations. Continued evaluation of crozier removal utilizing all 91 populations and removal of only marketable sized fiddleheads. Tissue culture micro-propagation of the five best populations.

Project 85-26

TITLE: Nutrition and Management Studies

LEADER: L. J. Eaton

OBJECTIVES:

1. To measure effects of long term management practices on growth and yield of lowbush blueberries.

2. To study effects of mechanical pruning versus burning on growth and yield of lowbush blueberries.

PROGRESS:

1. Long term fertilization: - Continued use of fertilizer over three cycles (6 years) increased yields. In 1985, fertilizer was applied to selected plots. Yields will be taken again in 1986.

2. Mowing versus burning: - In a project initiated in the fall of 1984, growth of plants in burned plots was similar to that in mowed plots. Yields from four locations will be taken in 1986.

It is hoped that this project can be run for at least three cycles in order to measure long term effects of mowing versus burning.

Project 85-29

TITLE: Nutrient uptake and the role of organic matter in maintaining lowbush blueberry production

LEADER: P. R. Warman

OBJECTIVES:

1. Field Study: (a) to determine the influence of various fertilizers and organic amendments on lowbush blueberry production in the field; (b) to compare growth and blueberry production (1) pruned mechanically by flail mowing and (2) thermally by oil burning.

2. Lysimeter Study: (a) to determine the efficiency of nutrient uptake by two cultivars of the lowbush blueberry from a soil fertilized with different amendments; (b) to relate blueberry tissue analysis of macro- and micronutrients with soil test levels for the plant available quantities of these same nutrients.

PROGRESS:

1. The four-year study was completed in 1985, which represented the harvest year of the second two-year growth cycle. Seven manure, fertilizer, or sawdust treatments at Diligent River, N. S. (on Hebert gravelly l. sand) produced fruit yields which were no greater than the control. Burning, however, for the second consecutive harvest, produced yields significantly greater than mowing over all treatments. Tissue analysis (whole plants) at harvest revealed that of all the treatments only the N content of mowed plants was higher than burned plants. Chicken, dairy and swine manure amended plants contained the highest levels of macronutrients, while the urea fertilized plants contained the lowest levels. The complete fertilizer treatment (all essential nutrients added) produced the highest levels of micronutrients in the blueberry plants. The treatments, therefore, had a greater influence on plant nutrition than on fruit yield.

2. Lysimeters were filled with Hebert s. loam in 1982 and planted with the blueberry cultivars ME3 or 508. Plants were treated with dairy manure, green manure or fertilizer for 3 years at the equivalent of 50 kg/he N. Whole plants were harvested in September (1985), sectioned, and analysed for macro- and micronutrients. The treatment response was quite variable; variety differences, however, were very apparent in the root tissue analysis, where the macronutrient levels in the 508 cultivar exceeded the ME3 cultivar. Cultivar differences were not as obvious in the leaf and stem analysis. The soil was sampled in September at two depths and analysed for pH, organic C and available macronutrients. The dairy and green manure treatments improved organic C and the levels of extractable soil macronutrients relative to the Control (0 fertilizer); the fertilizer treatment decreased the soil pH and the extractable Ca and Mg content of the lysimeter soils. The surface 15 cm of soil was higher in Ph and fertility relative to the 15-30 cm soil depth.

Project 85-30

TITLE: American Ginseng Production in Nova Scotia

LEADER: H.-Y. Ju

OBJECTIVE: To test the feasibility of commercially cultivated American ginseng in Nova Scotia.

PROGRESS:

Very serious disease infections on foliage and roots of 2 and 3 year-old-plants were found in late August 1985. Infected tissue samples were taken to the Biology Department and the following pathogens were identified: Schlerotinia in leaf, Aspergillus in stem, Rhizopus and Fusarium in crown of root and Ramularia in root. All plots were treated with Captan and Benlate mixtures as soil drench.

Ginseng plants are susceptible to a number of diseases and some of them are rather severe, such as Ramularia. Ramularia root rot can wipe out whole plots very quickly. As the current ginseng plots are surrounded by grasses in the N. S. A. C. orchard, great attention has been provided on controlling diseases. In 1984, Alternaria panax, a pathogen caused Alternaria blight and root rot was found in both leaf and root from a few plants.

Samples of healthy roots were randomly harvested and evaluated. The three year old ginseng weight was 13.6 -+ 2.1 gram/root, showing long narrow type roots. First year old ginseng planted in fall 1984 were seriously damaged by Gramoxone from orchard weed spray.

A new shade structure of two units (single unit: 3.6 x 3.6 x 1.8 m height) was constructed in fall 1985. Stratified ginseng seeds were sown in six beds (raised and rounded) using a close spacing (15 cm between rows and 2-3 cm between seeds).

FUTURE PLANS:

1. The new shade structure established in fall 1985 in Plumdale will be covered using a new woven material, i. e. "Cool Poly" (improved ventilation). The structure will be extended.
2. The treated plot in the orchard with Captan and Benlate solutions will be examined.
3. Fertility studies (foliar spray using mixture of 20-20-20 and fungicide) will be conducted.
4. Growth retardants (i. e. PP333) will be tested for growth and fungicidal effects.

Project 85-31

TITLE: Arsenic Release from High Arsenic Soil

LEADER: K. S. MacLean

OBJECTIVE: To study the rate of release of arsenic from Nova Scotia orchard soils, containing high levels of total arsenic, as influenced by redox conditions.

To determine the total arsenic content of selected Nova Scotia soils and correlate these levels with redox parameters.

PROGRESS:

Studies on the release of arsenic from soil having a high total arsenic content show that under strongly reducing conditions arsenic is readily released into the soil solution. As the redox potentials of the soil-water mixture are progressively changed from reducing conditions to oxidizing conditions less arsenic is released. At high oxidation states there is again a slow increase in the amount of arsenic released.

Varying the pH of the soil-water solution indicated that arsenic release is pH dependent, however the overall distribution release pattern remained the same.

Analysis of selected non-orchard soils from Pictou, Kings and Halifax Counties for total arsenic gave a range of values from 1.74 to 79.63 p. p. m. The highest average content of arsenic was found in soils from Halifax County (16 ppm) followed by Kings and Pictou County soils (14 ppm and 7 ppm) respectively.

Project 85-32

TITLE: Pesticide effects on nitrogen cycling in Maritime soils

LEADER: G. W. Stratton

OBJECTIVES: To study the effects of selected pesticides (endosulfan, permethrin, atrazine, glyphosate), both alone and in combination, towards nitrogen fixation in soil and by pure cultures of nitrogenase-possessing bacteria. There is a lack of adequate research on effects of pesticides in association with other compounds, although this is the situation occurring in situ. Degradation products will also be evaluated since this information is absent from the literature. To evaluate the effects of selected pesticides on nitrification in soil, both alone and in combination. To determine the influence of some abiotic factors (environmental factors, solvents, heavy metals) on pesticide effects towards the above processes. To compare various methods of monitoring the above processes as to their efficiency in determining deleterious effects.

PROGRESS:

Final experiments were conducted under this project. Data were obtained and submitted for publication on factors affecting solvent-pesticide interactions in laboratory bioassays towards soil microorganisms. Temperature and pH, as well as nutritional parameters affected both the magnitude of interaction and the solvent and pesticide levels required to cause synergistic and antagonistic responses. None of these factors altered the actual interaction response observed. Pesticide toxicity was increased wherever moderating factors resulted in stressed growth conditions. It is recommended that bioassays for water-insoluble pesticides be standardized and that solvent effects be identified and eliminated using the procedures published from this research.

FUTURE PROGRAM:

Program terminated. All data are summarized in the following series of papers on solvent-pesticide interactions in bioassays:

Arch. Environ. Contam. Toxicol. 11: 437-445, 1982; Arch. Environ. Contam. Toxicol. 14: 651-658, 1985; Water, Air, Soil Pollut. 28: in press, 1986; Bull. Environ. Contam. Toxicol. 36: in press, 1986, and on interactions between pesticides and their degradation products; Bull. Environ. Contam. Toxicol. 34: 676-683, 1985; Arch. Environ. Contam. Toxicol. 13: 297-303, 1983; Pestic. Sci. 13: 679-685; Environ. Pollut. A29: 71-80, 1982.

Project 85-38

TITLE: A Preliminary Investigation into Analytical Methods for the Determination of Certain Additives, Nutritional Factors and Toxic Factors in Poultry Feeds.

LEADER: H. M. MacConnell

OBJECTIVES:

1. To investigate and establish reliable analytical methods for the determination of antibiotics such as aureomycin, lincomycin, penicillin, furazolidine and sulfamethazine in poultry feeds.

2. To determine in a preliminary investigation if high pressure liquid chromatography can be used as an analytical method for the determination of coccidiostats such as coban and amprolium in poultry feeds.

PROGRESS:

In the report submitted for 1984-85, it was noted that attempts to determine amprolium in poultry feed by use of high pressure liquid chromatography were not successful. The first efforts in the current year were directed to determining amprolium using a column and solvent combination that could also be used to simultaneously determine several other feed constituents. These different columns in combination with several solvent systems were tried without success.

All the results indicated that, due to its ionic nature, amprolium was not separated satisfactorily from other components of the poultry feed by use of the C18 reverse phase column. This type of column was found to be very satisfactory for the analysis of a number of poultry feed additives.

When an Altex Ultrasphere Ion Pairing column was used in conjunction with a methanal-water solvent containing hexane sulfonate and dibutylamine, it was possible to separate amprolium from the natural components present in poultry feeds. Preliminary data indicated that this method can be used to determine amprolium with recoveries of about 96-100%. One disadvantage of this method is that the ion pairing column cannot be used to determine other antibiotics and coccidiostats.

The use of reverse phase columns for the analysis of antibiotics worked very well with standard samples. Use of these methods on feed samples produced results that indicated variable recoveries.

Project 85-42

TITLE: Micronutrient Studies in Lowbush Blueberry Crop

LEADER: H.-Y. Ju

OBJECTIVE: To study the effect of boron foliar application on growth and yield of lowbush blueberry crop.

PROGRESS:

Boron nutritional studies have been carried out since 1982. Atlantic soils are commonly deficient in boron, an essential micronutrient which seems to be important in flower bud formation. Selected lowbush blueberry clones cv. Augusta (established in 1982) in Great Village, N. S. were sprayed with four different concentrations of boron (0, 10, 100 and 1000 ppm) at the bloom stage in June 1985. At harvest, on August 6, 1985, number of shoots, shoot length, number of flower buds and number of fruit and fruit weight were collected. There were no significant differences among treatments in this experiment.

Previously, our laboratory demonstrated that flower bud formation was greater in plants which received a range of 0.1 - 2.5 ppm boron than in plants which received no boron or 12.5 ppm boron in hydroponic culture. However, several experiments conducted in the field as foliar sprays showed inconsistent results which might be due to the clonal variation in the wild stand of the field. Boron content in tissues may be sufficient when level of soil boron is low for a short period.

Project 85-45

TITLE: Digestibility Studies Using Nova Scotia Grown Feedstuffs

LEADER: D. M. Anderson

OBJECTIVE: To determine the dry matter, gross energy and crude protein digestibilities by pigs fed Nova Scotia grown crops.

PROGRESS:

The following feedstuffs have been evaluated in the previously run digestibility studies:

1. Trial 1 Nova Scotia grown corn and soybean
2. Trial 2 Nova Scotia grown corn and canola seed
3. Trial 3 Nova Scotia produced fish silage and corn
4. Trial 4 Crab meal.

The status of these trials is that all the in-barn work is completed but a small quantity of laboratory analysis and statistical analysis needs to be completed to allow reporting coefficients of digestion for dry matter, gross energy and crude protein in these feedstuffs.

Digestible energy and protein for Nova Scotia grown corn, soybean and canola meal, fish silage prepared in Nova Scotia and crab meal available in Nova Scotia will be presented when data analysis is complete.

At present data from some of these trials is being subjected to statistical interpretation while other data is being completed in laboratory analysis.

Project 85-46

TITLE: Turfgrass Management

LEADER: R. W. Daniels

OBJECTIVE: To determine and demonstrate most recent turfgrass management practices.

PROGRESS:

Ten cultivars of perennial ryegrass were rated for their overwintering ability. The percent turfgrass lost due to winter injury ranged from 10.8 to 70 percent. Their percent recovery ranged from 85.0 to 100. This demonstrates the great variability in this turfgrass species in respect to overwintering and recuperative ability.

Three perennial ryegrass cvs. 'Linn', 'Loretta' and 'Manhattan', representing grasses with poor, average and good overwintering ability were fertilized with various sources of nitrogen. In respect to degree of winter-kill the grasses responded as expected. Those fertilized with nitrate (as the nitrogen source) had the highest incidence of winterkill. This is due to their high uptake of nitrogen from this fertilizer source and in so doing they did not properly "harden off" prior to winter.

When various nitrogen sources and potassium levels were evaluated, a modern addition of potassium resulted in the lowest incidence of winterkill.

Project 85-50

TITLE: Development of Orchard Mower Floating Extension

LEADER: F. L. Desir and M. N. Rifai

OBJECTIVE:

1. To complete the development of an orchard mower floating extension capable of functioning on any slope, and equipped with an automatic retraction mechanism to allow mowing around trees without tree damage.

2. To modify the extension system so that it will be compatible with all farm tractors 44.7 kw (60 hp) and over.

PROGRESS:

During the two previous summers, a floating system had been developed for a hydraulic mower extension or outrigger, and it was equipped with an automatic retraction system. The floating system enabled the outrigger to mow satisfactorily between trees on cambered beds of any slope. The retraction mechanism operated automatically, retracting the outrigger when it came close to a tree, and returning it as soon as the tree was passed. This allowed the outrigger to mow closely around trees with little danger of bark damage, especially to weak or irregular trees. An over-ride switch allowed the operator to retract the outrigger at any time if necessary. However, the retraction system worked well only with tractors of 56 kw (75 hp) or more.

Research and development efforts during the summer of 1985 were aimed at modifying the retraction system, so that it would operate efficiently with farm tractors of 44.7 kw (60 hp) or more. One possible solution investigated was to provide the mechanism with its own hydraulic system, so as to be independent of the tractor hydraulics. This option was rejected because it made the outrigger unit too expensive, and it required too much power from the tractor for satisfactory operation. Other options tested included modifications to make the outrigger much lighter to reduce its power requirements, and to eliminate its support frame and wheels as an alternative means of preventing tree damage.

The final solution involved modification of the outrigger retraction and motor hydraulic circuits, to allow maximum hydraulic output from the tractor to flow freely through the outrigger system. Proper sequencing of the motor and retraction circuits allowed full power to the outrigger motor during normal operation, rapid retraction when needed, and motor operation during retraction and return.

The modified unit was tested satisfactorily with a 44.7 kw (60 hp) tractor on the cambered orchard beds at Kentville Research Station. The performance of the unit brought this project to a successful conclusion.

Project 85-51

TITLE: Computerized Environmental Control and Management System for Poultry Production Facilities.

LEADER: D. C. Crober

OBJECTIVE: To design, develop and test a microcomputer-based environmental control and management system for a poultry building.

PROGRESS:

The system under development will employ specialized software and selected commercial micro-electronic components and related sensing accessories. Design of the overall system is completed, and software preparation is underway. This software consists of control and sensing instructions for the micro-processor, covering the full range of monitoring and control factors; user-interface software for both instruction-passing and reporting purposes; and diagnostic software for individual system installation and refinement. A prototype system is scheduled for installation in an N. S. A. C. caged layer facility in the fall of 1986. This system will control ventilation and lighting and will monitor feed and water consumption and egg production.

This project is being jointly supported by the Atlantic Institute of Biotechnology, the N. S. Department of Agriculture and Marketing Research Committee, the Canadian Egg Marketing Agency and the Ontario Egg Producers' Marketing Board.

Project 85-52

TITLE: Herbicide Pathogen Interactions in Quackgrass

LEADER: M. G. Sampson

OBJECTIVES:

1. To determine if there is any variation between various populations of quackgrass in response to glyphosate, sethoxydim, fluazifop-butyl and Assure™.

2. To determine if there are any interactions between herbicides and pathogens of quackgrass which would either decrease or increase the efficacy of these herbicides.

PROGRESS:

Herbicide tolerance:

To investigate the possible existence of intraspecific variation to herbicides in quackgrass in Nova Scotia, several clones were collected and propagated in the greenhouse. Greenhouse and field experiments were established in which these clones were planted and sprayed with a high and low rate of glyphosate (2.25 kg ai/ha and 1.12 kg ai/ha) and sethoxydim (0.8 kg ai/ha and 0.4 kg ai/ha). Results indicated that a clone from West Branch, Pictou County was very tolerant to both glyphosate and sethoxydim. Clones from Bible Hill, N. S. and Kingston, P. E. I. were also very tolerant to glyphosate. There was also significant variation in control in mixed populations chosen at random from various locations in Nova Scotia.

The reasons for this differential tolerance to these herbicides has yet to be determined. The decrease in variation of herbicide response at the high rate of glyphosate when compared to the lower rate, suggests that the results may be due to differences in the amounts of herbicide being absorbed and/or translocated. The important point is that there were significant differences in response between some of the clones. Higher rates may be required to control these more tolerant clones.

Studies were conducted in a greenhouse to investigate the influence of leaf diseases on quackgrass control with glyphosate. A factorial experiment in a randomized complete block design was established in which diseased and healthy plants were sprayed at the 8-10 leaf stage with glyphosate at a rate of 2.25 kg ai/ha or left untreated. Results were recorded as dead shoots, shoot dry weight, rhizome dry weight and number of rhizome buds at 2, 4 and 6 weeks after treatment.

Preliminary results indicate that there were no significant differences between herbicide treatments for dead shoot dry weight ($\alpha = 0.1$). Rhizome weight and number of buds, in diseased plants

treated with glyphosate were significantly higher than healthy plants treated with glyphosate. In addition, regrowth occurred from both underground and above ground portions of diseased plants treated with glyphosate. New shoots often emerged from nodes near the soil surface from apparently dead plants. A subsequent experiment indicated that this regrowth may occur at rates as high as 3.0 kg ai/ha. This suggests that the herbicide was effective in destroying the living green tissue, but the necrotic tissue may have been reducing the amount of herbicide absorbed and/or translocated to lower portions of the plant, and therefore reducing the level of control obtained.

From a practical point of view, in a field situation, disease levels on quackgrass can be high enough in some areas to give extensive necrotic tissue late in the season. This can interfere with the activity of herbicides used to control quackgrass. Although the extent of the reduction in control may not be immediately apparent, there may be sufficient viable buds remaining to aid in the recovery of the weed from control measures.

Project 85-53

TITLE: Control of winter wheat and barley diseases.

LEADER: A. B. Gray

OBJECTIVE: To identify races of Erysiphe graminis f. sp. tritici present in the Maritimes.

To estimate disease thresholds and losses due to specific barley diseases.

PROGRESS:

1. Races of Erysiphe graminis f. sp. tritici present in the Maritimes were not virulent on wheat carrying the following genes for resistance:

Nova Scotia: Pm3a, Pm3b, Pm8
New Brunswick: Pm3b, Pm7, Pm8
Prince Edward Island: Pm1,Pm2, Pm3a, Pm3b, Pm4, Pm8

2. Disease epidemics of differing intensities were artificially created in field plots by inoculating with spores of Pyrenophora teres using a) different inoculation dates, and b) different spore concentrations as inoculum. The greatest variation in disease intensity occurred when different spore concentrations were used. Yield loss correlated best with disease ratings made too late in the season to affect a decision to spray by the grower. The foliar fungicide tilt slowed disease development in each epidemic.

3. Growth cabinet studies revealed that P. teres lesion development was faster on the susceptible cv. Laurier at 24°C than at 21, 18 or 15°C. However, on the more resistant cv. Bruce, lesion development was faster at 18 and 15°C than at 24 or 21°C, suggesting that resistance is expressed at warmer temperatures. The fungus grew faster on growth medium at 24°C than at 21, 18 or 15°C.

Project 85-57

TITLE: Mash Versus Pelleted Diets for Growing Swine

LEADER: D. M. Anderson

OBJECTIVE: To compare the performance of grown-finisher pigs (20-100 kg liveweight) fed diets based on Nova Scotia grown soybeans presented to the pig in either a mash or pelleted form.

PROGRESS:

The research involved grower-finisher pigs (20-100 kg) fed 16% crude protein rations. A standard corn-soybean meal ration was used as a control. Each replicate of the experiment included 7 pens (3 mash, 3 pellets, 1 control) containing 8 pigs each. One replicate is presently in progress. Four replicates have been completed in the barn. The data from these replicates is presently being analysed statistically.

Daily feed consumptions, weight gain and feed efficiency were calculated. Carcass data normally collected on market pigs, (index, back fat and carcass weight) were obtained and will be reported in the final report.

Results of the experiment to date have been reported previously.

Project 85-65

TITLE: Ferulic Acid: A Possible Allelopathic Root Exudate

LEADER: A. R. Robinson

OBJECTIVES: The objective of the project was to demonstrate that sunflowers and wheat do, in fact, exude phenolic acids from their roots when grown hydroponically. The second objective was to identify the major phenolic acids in the root exudates which are suspected to be allelopathic.

PROGRESS:

Sunflowers and wheat were grown in 1/4 strength or less Hoagland nutrient solution. Each plant was injected with L-($u^{14}C$) phenylalanine by placing a crop (0.01 ml) on the auxillary bud area of the second and third sets of true leaves and then puncturing the stem with the syringe tip. The hydroponic solution which contained radioactive components was passed through amberlite XAD-Y resin. The adsorbed radioactive material was eluated from the column and run on thin layer chromatograms. Some of the radioactive components identified were caffeic and t-cinnamic acid. Other components which were not fully identified, did however behave like phenolic acids when run on TLC.

Sunflower seedlings, when grown in 1/8 strength Hoagland solution with all factorial combinations of 011 mM concentrations of caffeic, ferulic, t-cinnamic and p-coumaric acids, responded with significantly poorer growth as the number of acids in combination increased. It is speculated that the allelopathic nature of phenolic acids is thought to have some influence on the growth of wheat and sunflowers in rotations and in monocultures, particularly with poor soil fertility.

Project 85-66

TITLE: Cervical Mucus and Peroxidase and Heat Detection in Dairy Cattle

LEADER: A. R. Robinson

OBJECTIVES: The objective of the project was twofold. Firstly, to correlate mucus peroxidase activity in vaginal secretions to hormone changes throughout the estrous cycle of the dairy cow. Secondly, to determine if mucus peroxidase activity correlates with the time of estrus and ovulation in dairy cattle.

PROGRESS:

A simple reliable method of detecting heat and/or the time of ovulation in dairy cattle would facilitate A. I. as well as dairy management efficiency.

Samples of venous blood and vaginal mucus were collected from five cows throughout the estrus cycle and thrice daily around estrus. Plasma and processed mucus were stored at $-20^{o}C$ pending hormone assay by RIA and measurements of mucus peroxidase activity. In 3 of 5 cows typical hormone profiles were evident throughout the estrous cycle. Mucus peroxidase activity remained low (<0.100 absorbance) during the luteal phase. Peak activity was noted 2 1/3 and 3 2/3 days after observed estrus.

In one animal the hormone profile showed high progesterone levels during recorded estrus and a mucus peroxidase activity which remained low until the plasma progestrone concentration was basal for several days. Based on these results, peroxidase activity in vaginal mucus does not appear to show promise for development of a rapid test for estrus detection.

Project 85-67

TITLE: Corticosterone Levels and Layer Performance

LEADER: A. R. Robinson

OBJECTIVES: To develop a reliable high pressure liquid chromatography procedure for the determination of corticosterone in blood samples of laying poultry stock. The method should be comparable to radioimmunoassay procedures with respect to detection limits. The procedure once established would be applied to the determination of serum corticosterone levels in poultry stock to determine if a correlation exists between blood corticosterone-one levels, management variations and performance as well as genotype of laying stock.

PROGRESS:

Many analytical procedures are currently available for the determination of corticosterone in blood. These methods include photometry, fluorimetry and radioimmunoassay. However, all of these methods have revealed a lack of either sensitivity, specificity, reproducibility or convenience of analysis. In particular, interference with other steroids is a problem with all of these methods. The quantification of blood corticosterone by high pressure liquid chromatography would alleviate these problems.

A chromatographic procedure was developed in which the separation and quantification was done using a mobile phase of methanol-water (55:45) at a flow rate of 1 ml/min. The column used was a C_{18} reverse phase. The sensitivity of the method was measured by assessing the lower limits of detection and was found to be 11.0 ng/ml of blood plasma.

Since the corticosterone levels in poultry range from 1-15 ng/ml, the sensitivity of the present method is not adequate. In order to increase the sensitivity, a new UV detector is currently being used.

The extraction of corticosterone from blood plasma has been tried using petroleum ether. This solvlent does indeed extract the corticosterone but also extracts a large amount of lipid material which interferes in the analysis. A new extraction procedure is currently being developed which will overcome this problem.

Project 85-68

TITLE: Effect of temperature on the predatory mite, Typhlodromus pyri Scheuten (Acarina: phytoseiidae), development rates and its density on apple cultivars in Nova Scotia.

LEADER: J.-P. R. LeBlanc

OBJECTIVES: In Nova Scotia orchards the bionomics and life table data for T. pyri are a prerequisite for the implementation of IPM programmes. Therefore the objectives of this cooperative project with Kentville Research Station are to generate field and laboratory derived data on the effect of temperature on development rates, fecundity and predation of T. pyri.

PROGRESS:

A. Programme Progress

A comprehensive survey of the literature on the predatory mite T. pyri has been completed and it is constantly updated. It covers work carried out both in North America and in Europe. The necessary equipment for acarology work was purchased and familiarization has been initiated. Although the methods to be used in this project have been struck at its inception, we are presently establishing specific protocoles for the two next growing seasons.

B. Field Work Progress

During last summer, within our orchard blocks located at the Kentville Station experimental orchard, high population levels of the European red mite, P. ulmi, were induced by the application of insecticidal sprays. Later on, field collected individuals of the predatory mite, T. pyri, were released. Also, preliminary rearing trials of both species were successfully completed.

C. Graduate Student Progress

Upon graduation from McGill, the student joined us at N. S. A. C. and initiated her literature review. During last summer, Ms. Pace attended the Acarology Summer Program at Ohio State University and successfully sought admission in the graduate programme at the Department of Entomology of Macdonald College and at the Department of Biology of Dalhousie University. For convenience, we selected the latter. The student has completed the major part of her course requirements and will therefore be able to dedicate herself full time to research for the next two years of the program.

Project 85-69

TITLE: Test tube pollination of cultivated potatoes.

LEADER: A. R. Olson

OBJECTIVE: The development and refinement of reliable techniques leading to *in vitro* fertilization of potato ovules continues to be the highest priority. The goal is to provide plant breeders with methods to circumvent certain breeding barriers in order to develop and transfer new sources of potato germplasm.

PROGRESS:

During the summer of 1985, two specific techniques leading to test tube fertilization were identified and experimentation initiated. Plant materials used in this research include both diploid clones from the breeding reserve of Canada Agriculture, Fredericton and tetraploid, commercial varieties generously donated by the Plant Science Department, N. S. A. C.

Method 1. Placental pollination:

The procedure for the aseptic isolation of whole placentae from potato flowers was successfully outlined. Potato placentae were pollinated directly in sterile culture. Pollen was observed to germinate and form tubes, but a consistent film of water covering the ovules caused the pollen tubes to burst. A proposed modification of this technique involves the positioning of a piece of miracloth between the explant and the culture medium. The miracloth should prevent a water film from building up between the ovules. Presumably, pollen tubes would then be able to penetrate the ovules without bursting prematurely.

Method 2. Ovarian-dish pollination:

Very preliminary experiments using this method were attempted near the end of the summer 1985. The ovary of the potato flower with the attached calyx was maintained in sterile culture. The stigma, style, and upper ovarian wall were surgically removed exposing the placentae and ovules contained within. Pollen was deposited on and in this "dish" of ovules. The resulting pollen tubes should have encountered a natural physical and biochemical environment. The results were very encouraging as pollen germinated and formed numerous tubes.

Further refinement of these two techniques is currently underway as growth media requirements are still in question. Continuous experimentation is, therefore, projected through 1986. If either or both of these techniques should prove successful, there will be a direct and immediate application to the potato breeding programs in Canada and abroad.

Project 85-70

TITLE: Germplasm preservation by freeze drying:
I. Potato and White Clover

LEADER: J. Nowak

OBJECTIVE: The conservation of genetic resources has been one of the major concerns of plant breeders and agricultural producers. A large portion of the world's germplasm must be maintained in the clonal form. The cost of its maintenance is very high and there is always a risk that the material can be lost as a result of disease outbreak or pest invasion. In recent years biotechnology offers several solutions to this problem. In vitro grown plants, their fragments or tissues are being utilized for long-term germplasm preservation. None of the tested methods (cryopreservation, slow growth techniques) however, have been very efficient so far. There is a great problem to regenerate plants from the cryopreserved tissues. The other methods of germplasm maintenance require subculturing of the plant material which might lead to genetic deviations. Freeze-drying is being proposed an an alternative and convenient method of germplasm preservation. Potato and white clover plants were chosen by the applicant as the objects of this experiment since they can be easily propagated in vitro and can produce organogenic cultures.

During the proposed period of the project, developing the following research will be undertaken:
1) Suspension cultures will be obtained from highly regenerative calluses of white clover and tested for their regenerative ability;
2) Screening for organogenic potato calluses will be continued and regenerative cell lines will be established;
3) All forms of the in vitro grown material with regenerative ability (cell suspensions, calluses, shoot tips, stolons and microtubers) will be freeze dried.

PROGRESS:

Since different plant tissues react differently to freezing and exhibit different regeneration abilities, in the first phase of the project in vitro cultures of six cultivars of potato and ten cultivars and local ecotypes of white clover were established. Different explants were tested and it was found that stolon tips of potato (taken from the hydroponically grown plants) and hypocotyls of white clover are the most convenient parts for quick establishment of in vitro cultures. In the second phase of the

project, callus cultures are being initiated and tested for their regenerative ability. Only plant populations which give highly regenerative calluses and cell suspensions will be used for freeze drying experiments.

It was found that the most vigorously grown clones of white clover usually respond with good callusing. Several calluses were found to be organogenic. The selected, highly regenerative plant populations are being multiplied at present and part of the material has already been placed in $5^{o}C$, under 8 h photoperiod and 26 Einst. m^{-2} s^{-1} light intensity for low temperature storage.

The plant populations which generate organogenic calluses will be used to obtain cell suspension cultures. Microtubers and metamorphized stems of potato have also been produced *in vitro* during the development of the project. It was found that ethylene generated by plantlets grown in the sealed containers modifies stems and allows storage of plantlets under standard growth conditions (16 h photoperiod, $24^{o}C$) for 10 months without affecting their regenerating ability. Microtubers could easily be produced by adding 10 ppm ethrel into the medium. The microtubers produced either in the presence of a high conventration of sucrose (in the dark) or the ones induced in the presence of ethrel were able to sprout after GA_3 treatment at $30^{o}C$ for 2 hours and planting in perlite.

All forms of the *in vitro* grown material (cell suspension, callus, shoot tips, stolons, microtubers) with a high regeneration ability will be utilized in phase three of the project - testing of the freeze-drying technique for germplasm preservation. The cultures will be exposed to decreasing temperature gradients in the presence of cryoprotectants, to avoid ice crystal formation, and freeze dried. The freeze-dried material will then be tested for regeneration ability.

Project 85-71

TITLE: New method for reporting pesticide toxicity data.

LEADER: G. W. Stratton

OBJECTIVE: To develop a simple toxicity index that takes into account the "potential exposure" in a bioassay, and which can be used to replace the terms LC_{50} and EC_{50}. This will involve performing replicate bioassays towards the invertebrate Daphnia magna and the alga Chlorella pyrenoidosa in containers of varying volumes and correlating toxicity data with total exposure units. A pesticide will be used as test compound (permethrin or atrazine). Daphnia will be tested in the earlier experiments. Standard bioassay procedures and statistical evaluations will be employed, except that container volume will be the variable tested.
BENEFITS: This project will supply information that will be extremely useful to any researcher undertaking bioassays. It will allow the development of standardized bioassays, making it easier to compare data from different research laboratories.

PROGRESS:

Appropriate toxicity data were obtained for Daphnia magna using DDT as the test compound. Bioassays were performed in varying volumes and both LD_{50} and lethal exposure indices calculated.

FUTURE PROGRAM:

Statistical analysis and radioisotope experiments will be conducted to provide further data on exposure potentials.

Project 85-72

TITLE: The effects of plant cover on soil chemical and physical properties

LEADER: P. R. Warman

OBJECTIVES: (1) To establish a number of cover crops in different soils in the field and growth room.

(2) To determine the response of the crops to various fertilizer treatments.

(3) To analyse the effect of the incorporation of the cover crop on selected soil chemical and physical properties.

PROGRESS:

Financial constraints forced us to modify our objectives and field design. Three legumes (Austrian winter pea, tangier flatpea, and sweet clover) were seeded into a Truro s. loam at Clifton, N. S. using 10 micronutrient treatments in 4 replications. All plots received recommended soil test levels of $N\text{-}P_2O_5\text{-}K_2O$. Treatments were Control and 3 rates each of B, Co and Mo. Plant yields and tissue analysis of macro- and micronutrients were recorded. Treatments had only a minor impact on plant yield, but treatments significantly influenced the plant nutrient uptake. The average dry matter yields and the associated N content in the tops of the 3 legume species at the August, 1985 harvest are as follows: Austrian winter pea - 7.6 MT/ha, 240 kg/ha N; tangier flatpea - 5.7 MT/ha, 180 kg/ha N; sweet clover - 3.4 MT/ha, 126 kg/ha N. It should be noted that of the 3 species, the remaining sweet clover continued to grow and fox N_2 long after the harvest date.

Project 85-73

TITLE: Asparagus-legume intercropping for soil conservation and fertility maintenance

LEADER: P. R. Warman

OBJECTIVES:

1. To establish 1-year old asparagus plants in 3 soils of contrasting soil physical and chemical properties.

2. To determine the crop response to different rates and sources of inorganic and organic fertilizers.

3. To determine the effect of different legume-intercrops on plant growth and nutrition.

PROGRESS:

Approximately 1000 plants were successfully transplanted into 3 different soils, usisng 12 plants/plot. Shoot counts taken in September indicated that the fertility amendments did not influence the count, although the July tissue analysis showed that the plants fertilized with Mg and B absorbed and translocated these nutrients throughout the plant.

Based on the plant response to different rates of P_2O_5 fertilizer we suspect that the soil test recommendations for P_2O_5 are not correct and require further refinement.

Six legume intercrops were seeded between the asparagus rows at two of the sites. The 1985 results indicated that one should consider wild white clover and white dutch clover as intercrops for mature asparagus stands; whereas sweet clover, vetch and Austrian winter peas appeared to compete too effectively for light in the immature asparagus plantations.

Project 85-74

TITLE: Growth Regulator Studies on Lowbush Blueberry Crop

LEADER: H.-Y. Ju

OBJECTIVE: To study the effect of growth retardants on the growth of lowbush blueberry crop.

PROGRESS:

I. Effect of A-Rest, Alar, Cycocel, Ethrel and Paclobutrazol foliar spray on the Growth of 'Chignecto' Lowbush Blueberry.

In June, greenhouse grown 'Chignecto' lowbush blueberry plants were sprayed with A-Rest - 50 ppm, Alar - 2500 ppm, Cycocel - 1500 ppm, Ethrel - 500 ppm and Paclobutrazol (PP333) - 500 ppm. In September, growth data including total shoot length, number of side shoots and number of flower buds were collected at harvest. Growth retardants reduced total shoot length 12, 32, 20, 1 and 36% respectively over the control (distilled water). Number of side shoots were decreased 6, 28, 18, 18 and 31% respectively over the control. In flower bud measurements, only the Ethrel spray treatment increased number of flower beds by 11% over the control.

II. Effect of PP333 - foliar spray and soil drench on flower buds of 'Chignecto' lowbush blueberry.

In June, PP333 was applied as soil drench (0, 0.1, 0.5, 2.5 and 12.5 kg a.i/ha) and foliar spray (0, 10, 100, 1000 and 10,000 ppm a.i.) to 'Chignecto' lowbush blueberries grown in the greenhouse in 20 cm pots with a mixture of sand and Promix (1:2, v/v). In September, all growth data including number of flower buds were collected at harvest.

In the soil drench experiment, number of flower buds was increased 72, 52, 46 and 20% respectively over the control. In foliar experiment, number of flower buds was increased 9, 6, 21 and 15% respectively over the control. From the two experiments it appears that the soil drench application of this chemical is more effective than foliar application.

FUTURE PLANS:

Although there was initial work on growth regulator studies in 1985, it seems that there is a need for more experiments on the topics, particularly in field conditions.

1) Chignecto and NB3 clones established at the N. S. Blueberry Institute will be used for growth regulator studies.

2) Paclobutrazol foliar spray and soil drench will also be applied to a commercial field plot for both sprouting and fruiting year crops.
3) Growth and yield data will be collected and fungicidal effect will be evaluated.
4) Clone propagational work will be continued at the N. S. Blueberry Institute.

Project 85-75

TITLE: Direct, rapid radioassay for tritiated water (^{3}HOH) in soil samples

LEADER: J. C. Miller

OBJECTIVES: Development of a rapid tritium radioassay which allows moist soil samples containing tritiated water to be mixed directly with the liquid scintillation cocktail.

The use of tritiated water (^{3}HOH) as a tracer is an important technique in studies of water movement and solute transport in soil. Modern liquid scintillation counters allow for rapid and convenient assays of tritium. However, the preparation of soil samples for assay of tritiated water involves the separation of water from soil by either centrifugation or distillation.

A substantial saving in time and labour could be achieved if the moist soil sample could be mixed directly with the scintillation cocktail for LSC of tritium activity. It is the objective of this project to develop a system for counting and quench correction in the ^{3}HOH-soil-scintillation cocktail mixtures.

PROGRESS:

The technique being developed worked for soil samples taken from the B horizon of a Queens Loam soil. Six different liquid scintillation cocktails, including one commercially available cocktail and one standard lab-prepared cocktail, were compared and it was determined that a dioxane-based cocktail formulated in our lab was the most efficient for direct assays of soil-borne ^{3}HOH.

The effects of varying the mass of soil and the volume of water present in the sample and the effects of settling time of the sample in the cocktail were assessed. Efficiency curves were generated for samples containing from 0 to 5 grams of soil and from 0.5 to 4 ml. of water.

The study is continuing During the summer of 1986. The LS cocktail formulated will be tested on soil samples with different chemical and physical properties from the one used in 1985.

Project 85-76

TITLE: Identifying key variables in dairy cow husbandry

LEADER: T. Tennessen

OBJECTIVE: To identify husbandry variables in dairy production related specifically to the attitudes and handling methods of the dairy farmer. Differences in such man-animal factors relate directly to production because they affect the ease, well-being and adaptibility of the cows.

PROGRESS:

Dairy producers were interviewed to determine which husbandry practices they consider useful. A questionnaire was then drawn up emphasizing the following areas:

(1) methods used to raise calves and introduce them into the herd;
(2) handling of milking cows, milking procedure;
(3) barn conditions, housing, feeding;
(4) herd health;
(5) cow performance.

Replies are being collected.

Project 85-77

TITLE: Improving cage design for laying hens. Stage 1

LEADER: T. Tennessen

OBJECTIVES: To improve the design of cages for laying hens, taking into account the species - typical behaviour of hens. Both questions of welfare and productivity are being addressed.

PROGRESS:

In Stage 1 of this project, the birds were given access to litter floor, to perches and to nest boxes. These were arranged within a three-level enclosure that had originally been a standard battery cage framework. Ramps lead from one level to another. Eggs laid in nest-boxes rolled out for easy collection.

Hens made use of all levels. Dust-bathing was observed, and the birds made frequent use of perches. The next-boxes were also successful, and only 1.7% of the eggs were laid on the litter floor. Overall "hen-day" production was 84.6%.

FUTURE PLANS:

Stage 2

1. Cage design will be refined to minimize the percentage of eggs laid on the litter floor and to improve manure collection.

2. Stocking density will be increased and egg production in the experimental housing will be compared to that in standard commercial cages.

Project 85-78

TITLE: Development of Reference Crop Evapotranspiration

LEADER: A. Madani

OBJECTIVE: To determine reference crop evapotranspiration for the Province of Nova Scotia

PROGRESS:

In this study only reference crop evapotranspiration (ETo) was theoretically determined for various locations in Nova Scotia, accounting for the climatic effect on crop water requirements. Of the many methods used to determine ETo, only a few were chosen. The decision was based mainly on available climatic data. Statistical analysis is being performed to compare the methods for significance.

At a later time, the crop coefficient will be determined in order to incorporate specific crop characteristics into crop water requirements. The effect of local conditions and agricultural practices on crop water needs will also be introduced. The final outcome will be to assist Nova Scotian farmers in irrigation scheduling at various Nova Scotia agricultural centres.

Project 85-80

TITLE: Influence of source and amount of dietary calcium on blood mineral profile and incidence of milk fever in peri-parturient dairy cows.

LEADER: A. H. Fredeen

OBJECTIVE: Milk fever (parturient paresis due to hypocalcemia) is a metabolic disease of considerable economic importance that occurs primarily in high-producing dairy cows. Current methods of prevention may deplete bone mineral reserves and lead to reproductive inefficiency. The objectives of this research were to develop an experimental diet that would prevent milk fever while supplying sufficient calcium, and to examine the effects of this diet on blood mineral profile in peri-parturient dairy cows.

PROGRESS:

Three concentrates were formulated to contain different sources or amounts of calcium and phosphorus. Two were lactation concentrates differing only in source of calcium and phosphorus (0.8% calcium, 0.5% phosphorus; as fed basis), one was a dry cow concentrate with restricted amounts of calcium (0.5% calcium, 0.5% phosphorus; as fed basis). Sources of supplemental calcium and phosphorus in lactation concentrates were either calcium carbonate and dicalcium phosphate (ALKALI) or calcium chloride and ammonium phosphate (ACID). These concentrates contained approximately 30 and 15 meq (sodium + potassium - chloride)/100 g diet (as fed) respectively. Based on previous research, these diets probably induced subclinical alkalosis and acidosis respectively. The dry cow concenrate (DRY) contained calcium carbonate and dicalcium phosphate. Grass hay was fed free choice and concentrates were fed up to 5 kg/d for 2 wks pre-partum. At parturition, cows fed DRY were switched to ALKALI and concentrates were increased at the rate of 1 kg/d. After 7 d post-partum, cows fed ACID were switched to ALKALI which was fed to all cows throughout the remaining lactation.

All cows and heifers calving at the N. S. A. C. dairy unit are allocated to one of the three treatment concentrates. To date (April, 1986), 44 animals have completed the study. Breed and parity were considered when allocating animals to treatments. Average parities of cows were 2, 2.9 and 2.5 for ALKALI, ACID and DRY respectively. Numbers of Ayrshires and Holsteins assigned to ALKALI, ACID and DRY were 7 and 10, 7 and 9, and 7 and 4 respectively.

Cows were weighed weekly. Average body weights at calving

were 515, 550 and 540 kg for ALKALI, ACID and DRY respectively. Blood samples (from tail vein) were obtained daily at 1300h starting one week prior to estimated calving date and ending one week post-calving. Hematocrit was determined and plasma was collected for later mineral analysis. Mineral concentrations are currently being determined using inductively-coupled plasma emission spectrophotometry (Jerrel-Ash). Since initiation of this research, no cows or heifers have been treated for milk fever..

This project has been funded again in 1986-87.

Project 85-81

TITLE: Price Forecasting and Hedging by Maritime Feed-Grain Industry

LEADER: K. G. Grant

OBJECTIVE: To determine the usefulness of the Winnipeg Commodity Exchange's futures price quotations, adjusted for the Truro-Thunder Bay bases, as means of: (1) forecasting Nova Scotian feed-grain prices; and (2) hedging N. S. feed-grain crops, stocks held by the N. S. Winter Grain Marketing Board, stocks held by the private sector, and anticipated requirements by users.

PROGRESS:

This report covers research on the Winnipeg spot and futures markers for barley, feed wheat and oats.

For the spot markets weekly price data have been obtained for the 1977-78 to 1984-85 crop years, inclusive. Using the techniques of time-series analysis, it has been determined that, excepting price movements due to trend or seasonal influences, the weekly price changes for barley and oats are unpredictable. There is a slight ability to forecast the weekly change in the price of feed wheat. However, the extent of this predictibility is low and it does not appear that market participants could develop a profitable trading rule on the basis of it. Consequently, insofar as time-series analysis is concerned, these three markets appear to be price efficient.

For the futures mrkets, end-of-month price quotations for each barley, feed wheat and oats contract traded on the Winnipeg Commodity Exchange have been obtained for the 1974-75 to 1984-85 crop years, inclusive. For each contract type - for example, October barley - the end-of-contract price quotation (cash price) has been regressed on the price quotations at the end of each previous month of the contract's life.

This makes it possible to test two aspects of the performance of the futures markets. The first is the accuracy of futures price quotations as forecasts of spot prices. As expected, the more distant the contract's maturation the less accurate these forecasts tend to be; however, less transparent is the result that, in general, forecasting performance deteriorates less rapidly within crop years than it does across crop years. The second is the question of whether the futures price quotations are biased forecasts of spot prices. Utilizing an F-statistic test, the futures price quotations have been shown to be unbiased. This implies that producers who hedge on the Winnipeg market are able to shift the rask of price fluctuations to other market participants without paying a risk premium. This aspect of the market's performance favours its use by producers as a risk-shifting institution.

Project 85-82

TITLE: Analyzing Pricing Efficiency in the Eastern Canadian Table potato market.

LEADER: Y. Surry

OBJECTIVE: Assess the pricing efficiency of the Eastern Canadian table potato market. More specifically, the study aims at providing information on the following types of questions:

1) existance of lead, lag or simultaneous relationships among farm, wholesale and retail prices of table potatoes produced in Eastern Canada;

2) impact of U. S. potato prices and U. S. market conditions on the formation of potato prices in Eastern Canada;

3) the effect of market structure on the retail, wholesale and farm prices of table potatoes in Eastern Canda.

The method of investigation which is adopted consists of analyzing relationships among prices of table potatoes differentiated by origin at various levels (farm, wholesale and retail) and locations (Toronto, Montreal and Quebec City).

PROGRESS:

So far, research activities have consisted of:
1) collecting weekly data on farm and wholesale prices of fresh potatoes for Eastern Canada and the North Eastern United Staates. These data cover a five year period stretching between 1978-83.

2) developing a methodology capable of assessing the lead, lag or simultaneous relationships among prices. To this end, the concept of Granger-causality used by economists to test market price efficiency has been applied to the potato market by undertaking and testing dynamic linear regression among pairs of prices.

3) conducting preliminary analysis on farm and wholesale price time series of fresh potatoes for the Toronto, Montreal and Quebec City market places. The first statistical results indicate:

a) U. S. wholesale prices "cause" the wholesale prices of New Brunswick and P. E. I. potatoes in the three Eastern Canadian market places
b) a significant unidirectional relationship from farm prices to wholesale prices has been found for P. E. I., New Brunswick and Maine potato prices

c) prices paid to growers in New Brunswick, P. E. I. and Maine are determined simultaneously. None of them are leading the other.

FUTURE PLANS:

This research program is in its infancy stage. More in-depth work would be done in the following areas:

a) analyze the robustness of the established relationships by testing their forecasting ability, but also their statistical significance for different sample periods.

b) when lags occur among various prices, derive dynamic cultipliers between and among wholesale and farm prices. In so doing, a better knowledge of the time lags required for one price to respond to a change of another price would be known more accurately.

c) extend the analysis into two directions:
   a) so far, relationships between wholesale and farm prices of fresh potatoes in Eastern Canada has been analyzed. To get a more accurate picture of the market structure pertaining to this market, it is also necessary to investigate the linkages between wholesale and retail prices using the same methodology outlined above.
   b) connect the Eastern Canadian market with the Western potato growing states of the United States and undertake appropriate causality tests between these prices.

d) interpret thoroughly all the statistical results and draw the necessary policy and economic implications for the Eastern Canadian fresh potato sector.

Project 85-83

TITLE: Growth and carcass composition of broiler chickens

LEADER: D. L. Patterson

OBJECTIVES:

1) To determine the proportions of muscle, fat and bone in the carcass of a commercial broiler chicken strain at weekly intervals from hatching to slaughter;

2) To construct growth curves for live bird and carcass measurements;

3) To examine several methods of determining carcass composition based on live bird measurements.

PROGRESS:

Approximately 900 male broiler chicks of one commercial strain were raised from day-old to eight weeks of age on a standard corn-soybean meal diet. Of these birds, 200 were chosen at random for detailed live bird and carcass measurements. Starting at one week of age, the 200 birds were measured twice weekly for body weight, shank length and diameter, breast width and angle, and body depth and length. A further 120 birds were chosen at random and weighed in each period. At each of the twice-weekly intervals, ten birds of the 200 were slaughtered. Carcass measurements, including specific gravity, carcass volume, carcass shape and abdominal fat weight were taken. Each carcass was then cut in half, and one-half of each carcass was physically separated into retail cuts, then dissected into muscle, fat and bone.

Preliminary statistical analysis of the live bird measurements indicates that growth curves for body weight and most other traits are curvilinear to three weeks of age and linear after that time. Body weight shows no signs of plateauing by eight weeks of age. The 200 birds on the detailed study had an average one-day old weight of 37.4 g, and an average eight week body weight of 2886 g. At eight weeks of age, the remaining 734 birds averaged 2973 g, indicating that the frequent handling had very little effect on growth rate.

FUTURE PROGRAM:

Statistical analysis of carcass measurements and the relationship of these traits to live bird measurements is underway. The remaining half of a sample of the carcasses will be chemically analyzed to determine percent ether extractable fat. A further study has begun to compare growth rates and fat content of male and female birds of two broiler strains, and the relationship of plasma very low density lipoprotein levels to carcass fatness.

Project 85-84

TITLE: Wet versus Dry Feeds for Growth Lactation and Reproduction in Foxes

LEADER: D. M. Anderson

OBJECTIVES: To compare dry commercial and wet home mixed fox feeds on the basis of:

1. growth performance and pelt quality in weaned foxes;
2. reproductive performance of young foxes selected for breeding stock and established breeding females;
3. lactation performance of young and established vixens;
4. establish feeding guidelines for minimizing wastage by foxes receiving wet feeds.

PROGRESS:

The study was initiated to develop data on the rate of growth (g/day), feed consumption (g/day) and efficiency of feed utilization by weanling foxes fed wet or dry diets. The study was designed to evaluate wet feeding with dry feeding to determine the relative advantages of each system.

Dry diets offer advantages in feed handling and shelf life (keeping quality). Wet diets offer advantages from the perspective of utilization of locally available feedstuffs as example chicken by products, beef by products, horse meat or fish. These feedstuffs are not appropriate for dry diets.

A total of 55 weanling foxes (31 males, 24 females) aged approximately 7 weeks were randomly allotted to either wet or dry feeds. Foxes were divided into three groups based on birth day and housed two per pen up until 10 weeks of age and were then provided with individual pens (90 cm x 120 cm). Kits were weighed weekly and feed consumption determined at that time. Feed for the foxes receiving dry feed was available free choice. Water was provided in drinking cups and subsequently in automatic watering lines. Wet diets were mixed in 10 kg batches and retained in a freezer at $-18^{o}C$ until fed. Diets were formulated to meet or exceed (NRC, 1982) requirements for foxes. Wet diet was fed twice daily at 0830h and 1530h. Wet diet was fed to contain 35% dry matter.

Results of the experiment to date should be considered as preliminary only. The data is divided into two time periods. From 7-10 weeks of age foxes were pair caged. The growth rate of both wet-fed and dry-fed foxes were similar. The feed consumptions for both diets were measured on 90% Dry Matter basis. Foxes fed wet feed consumed more feed but did not convert this as effectively into body growth. Foxes had a tendency to waste more

wet feed. This additional waste is partially reflected in the poorer conversion of feed to gain.

For the next time period (10-17 weeks of age), comparisons were made not only between wet vs. dry feeds but also between males and females. As with the earlier data, foxes receiving wet feed consumed more feed but did not grow faster than dry fed foxes. The resulting effect on the conversion of feed to body weight gain was less efficient for those fed the wet diet.

Male pups appeared at this stage to grow about 4g/day faster than female pups.

Further analysis will be subjected to statistical evaluation and will be supplemented with economic data.

Project 85-85

TITLE: Heat Reclaimer Study

LEADER: D. Allen

OBJECTIVE: To develop a control system and evaluate two commercial heat exchanger units in a broiler building setting.

PROGRESS:

Two commercial heat exchangers were installed in the N. S. A. C. broiler facility December, 1985. Unit A was installed in the north side and Unit B was installed in the south wall. No serious effort was made to monitor the units as proper controllers and permanent electrical installation were not in place. Unit B was spot checked on two occasions and found to have a mass flow efficiency of 40% based on the following formula.

$$\frac{T_{in} - T_{out}}{T_{room} - T_{out}} \times \frac{Q\ (in)}{Q\ (out)}$$

WHERE:

T_{in} = Inlet Temp.

T_{out} = Outside Temp.

T_{room} = Room Temp.

$\frac{Q_{in}}{Q_{out}}$ = $\frac{\text{Inlet}}{\text{Outlet}}$ Flow Ratios

This efficiency is within the acceptable range for the temperatures during the test.

FUTURE PLANS:

1. Complete electrical installation and controllers (controllers have been purchased).

2. Collect data over suitable time period during heating season so that reliable efficiency values can be calculated. This will be done during the 1986-87 winter.

Project 85-86

TITLE: Density and Genotypic Effects on the Performance of Caged Layers.

LEADER: D. C. Crober

OBJECTIVE: To examine the interrelationship between genotype, stocking density and performance of caged laying stock.

PROGRESS:

Equal proportions of three strains of White Leghorns, obtained from the Animal Research Centre, Ottawa, were distributed at sexual maturity across six different cage size/stocking density treatment, i. e. - 4 birds/12"cage; 3 birds/12" cage; 3 birds/10" cage; 2 birds/8" cage; 1 bird/8" cage. (All cages are 16" high and 14" deep.) All birds were vaccinated for Newcastle Disease (ND) and Avian Encephalomyelitis (AE) during the growing period according to the recommended schedule. Data on social behaviour was collected on a sample of birds within each strain/treatment sub-group at 30 weeks of age. Egg production and mortality were monitored on an individual cage basis over the complete laying cycle. Blood samples were collected from a sample of birds within each strain/treatment group at 40 and 65 weeks of age. Antibody levels against Newcastle Disease (ND) and Avian Encephalomyelitis (AE) are being determined on each sample using the recently developed ELISA technique, which provides much greater quantitative precision than conventional serological procedures. Corticosterone level in the same blood samples, obtained through a complementary study will be used as an indicator of physiological stress associated with a particular strain/treatment combination. These data will also allow for direct determination of the degree of relationship between stress level and antibody-producing ability. Information collected on the behavioural effects of the different combinations will aid in interpretation of the stress/performance relationship observed.

Project 85-87

TITLE: Establishment and Validation of Hormone Assays

LEADER: M. L. Connor

OBJECTIVE: To establish and validate assays for several protein and polypeptide hormones using the gamma counter.

PROGRESS:

The hormones and antibodies for assay of bovine FSH, LH and PRL have been obtained.

The counting efficiency for ^{125}I using the Beckman gamma counter was established at 74.3 $\pm$ 3.1%. Trial runs to date have appeared successful. Experience with and validation of the assays for bLH, bFSH and other hormones will follow.

Project 85-88

TITLE: Soil Arthropod Survey of Nova Scotia Blueberry Fields

LEADER: J.-P. R. LeBlanc

OBJECTIVES: To initiate a soil arthropod survey of blueberry fields under different management practices.

PROGRESS:

During the first year of the project the construction of the Museum soil arthropod extractor was completed. Also a computerized controller programme was written. The extractor performances at different regimes of extraction were then tested with positive results.

The sampling plan was struck and with the collaboration of the Nova Scotia Blueberry Institute, soil samples were obtained and successfully processed with high level of extraction. Anticipated problems of extracting arthropods from the top soil layer did not materialize.

Our samples for this first phase were taken in a completely randomized design consisting of four treatments with eight replications. Each replication was the average of three sub-samples. The treatments considered were 1 - straw burned; 2 - soil burned; 3 - mowed; and 4 - natural growth. Presently more than 80% of the samples have been analyzed for arthropod content considering number per group and diversity of groups. It was possible to sort out specimens at the family level for ca. 50% of the samples and this will be completed shortly.

Our preliminary results are indicating a larger abundance of predatory species in both the mowed and natural growth treatments when compared to straw or oil burned ones. This suggests that mowing could be a preferred practice in blueberry production if the objective is to maintain a high level of beneficial arthropods in the soil.

FUTURE PLANS:

Because of the recent establishment of the W. H. Brittain Memorial Fund, I am not applying for a renewal at this time. The effort of the Committee last year to have permitted this project to take off was deeply appreciated. The project will continue using money generated by the Memorial Fund.

TITLE: Effect of post-storage temperature on quality and physiology of five pear cultivars.

LEADER: R. K. Prange, H.-Y. Ju, C. Embree and K. MacRae

OBJECTIVE: To evaluate pears harvested at Sheffield Farm, Agriculture Canada, Kentville and stored at different temperatures at N. S. A. C.

PROGRESS:

Five pear cultivars (Clapp's Favourite, Bartlett, Flemish Beauty, Bosc and Anjou) and four temperature treatments (5, 18, 22 and 26°C) were chosen for the study. The 5°C treatment was chosen as a typical refrigeration temperature for pears while 18, 22 and 26°C treatments were chosen as typical shelf/display temperatures. Each cultivar was analyzed separately. Measurements consisted of the following parameters: weight loss, ethylene production, respiration, core breakdown, pressure test, soluble solids, titratable acid, and dessert quality. Measurements were conducted every three days for a two week period.

Data from the study are presently being statistically analyzed. Observations during measurement periods showed that the Bartlett pears had the shortest ripening period and shelf life while the Anjou pears had the longest ripening period and shelf life. Ethylene production consistently peaked sooner for pears in the 18°C treatment and therefore resulted in the shortest shelf life. The 26°C treatment resulted in pears with a longer shelf life than the 28 or 22°C treatments but dessert quality was rated lower. This was probably due to a faster moisture loss at 26°C resulting in a slower physiological and chemical breakdown rate. The 5°C treatment resulted in pears with the longest shelf life and slower physiological changes but dessert quality ratings were poor.

FUTURE PROGRAM:

The experiments will be repeated again this fall. Additional experiments on chemical thinners and their effect on yield may be initiated.

(Funded by an agreement between the Kentville Research Station of Agriculture Canada and the Department of Plant Science.)

TITLE: The response of five cultivars of potato to polyethylene glycol induced water stress.

LEADER: R. K. Prange and K. G. Alexander

OBJECTIVES: To evaluate the technique of threshold potential determination of polyethylene glycol (PEG) stressed potato plants as a potential method of rapidly screening potato cultivars for drought resistance.

PROGRESS:

The five cultivars tested (Bintje, Desiree, Kennebec, Raritan and Russet Burbank) responded similarly, reacting faster to increased levels of stress. No significant differences were found between the threshold potential estimates of the five cultivars for 50% reductions in photosynthesis, transpiration and leaf conductance. The techniques of threshold determination showed its greatest promise for photosynthetic measurements. The monitoring of only photosynthesis might improve the sensitivity of the technique by allowing a closer spacing of measurements and a greater range of stresses to be used. The development of a rapid screening method to detect drought resistant cultivars might aid in increasing potato production in developing countries where water availability may be a limiting factor to agricultural production.

(Funded by an NSERC Post-Graduate Scholarship and an Agriculture Canada Operating Grant. The results are reported in an M. E. S. thesis (Dalhousie University) by K. Alexander.)

TITLE: The Gays River Mine Tailing Revegetation Study

LEADER: P. R. Warman

OBJECTIVES: To determine which plant species and the amount of fertilizers required to most successfully revegetate the mine tailings site.

PROGESS:

Field plots were established in 1983 on the tailings site of the lead/zinc mine. Eight indigenous and cultivated plant species were established and fertilized annually with up to 800 kg/ha of 12-24-24 fertilizer. Plots were maintained and evaluated over 3 growing seasons. The four most successful species were alfalfa, couch grass, meadow fescue and red clover; all plants required continual fertilizer applications. The heavy metal content of the plant tissue was so high that one would not recommend that the forage be used as livestock feed.

* Project supported by Esso Resources Canada

TITLE: Fertilizer use in lowbush blueberries

LEADER: L. J. Eaton

OBJECTIVES: To examine fertilizer nitrogen use in lowbush blueberries with respect to (1) seasonal fluctuations of inorganic nitrogen and nitrification; (2) possible losses of nitrogen through denitrification and (3) nitrogen cycling using ^{15}N labelled fertilizer.

PROGRESS:

(1) Seasonal Fluctuations: Blueberry sites that had been fertilized prior to this study exhibited high levels of nirate nitrogen during the season than did sites that were never fertilized. Also, soils from previously fertilized sites exhibited greater nitrification under laboratory conditions than did soils from never fertilized sites. This suggests that regular fertilization of lowbush blueberry soils stimulates populations of nitrifiers. Nitrification in these soils was low compared to agricultural soils. Thereore, it is unlikely that large losses of nitrogen via leaching or denitrification would occur under field conditions.

khizome nitrogen at a never fertilized site (Debert) increased more than at a previously fertilized site (Pigeon Hill), suggesting that more fertilizer nitrogen was taken up by the plants at the never fertilized site.

(2) Denitrification: This study revealed certain characteristics of denitrification in lowbush blueberry soils. Nitrous oxide is the major gas produced. It is produced under conditions of low oxygen (i. e. after waterlogging), adequate supply of carbohydrate, sufficient nitrate and temperatures of $20^{o}C$ or greater.

Under field conditions, all the conditions necessary for denitrification to occur are not likely to be present at the same time. When soil moisture is high and fertilizer nitrogen is present in early spring, soil temperature is usually low. When soil temperature is higher the sandy soils are not waterlogged.

Therefore, denitrification is likely not a source of significant nitrogen losses from lowbush blueberries.

(3) Nitrogen Cycling: We followed nitrogen through various plant and soil components at four sites for up to 16 months after application of ^{15}N labelled fertilizer as $(^{15}NH4)_2SO_4$.

Plants take up fertilizer nitrogen rapidly (30-50% by July and 45-62% by August) after fertilizer application in May.

A greater portion of plant nitrogen at the Pigeon Hill site came from fertilizer than that observed at Debert, and more fertilizer nitrogen remained in the litter at Debert. It is possible that slower movement of fertilizer nitrogen through the litter layer at Debert prevented the greater fertilizer nitrogen uptake suggesed in the first part of this study.

Over the two seasons following fertilization, we observed that the four systems examined conserved nitrogen such that 49 to 80% of the fertilizer nitrogen was recovered after 16 months. Recovery of labelled nitrogen in plants was similar at all sites. Two mechanisms of nitrogen conservation were observed. These were internal recycling (approximately 1/3 of the leaf nitrogen was moved into rhizomes and stems prior to leaf drop), and slow decay and mineralization of litter and soil.

We constructed nitrogen budgets at Pigeon Hill and Debert to illustrate pathways of nitrogen movement within these systems. These show that the Pigeon Hill system is balanced as long as approximately 40 kg N/ha is applied every two years to replace nitrogen lost by burning and harvest. There appeared to be a net loss of nitrogen at the Debert site, due in most part to greater losses of nitrogen by burning. Low natural inputs and losses in these budgets indicate the conservatory nature of the systems.

(Technology Development Project)

TITLE: Fishmeal and urea in diets of cows in early lactation.

LEADER: A. H. Fredeen

OBJECTIVE: Fishmeal is a by-product of the fishing industry in Atlantic Canada. It is a high quality protein supplement for livestock but the dairy industry in Atlantic Canada has traditionally not used this potentially less expensive supplement. For dairy cows, fishmeal is also a rumen undegradable protein that may improve milk yield in early lactation. However, there are few data showing effects of fishmeal with or without urea (rumen degradable crude protein) on dairy cow performance in early lactation. The objective of this research was to compare effects of fishmeal or fishmeal with urea to soybean meal in dairy diets on cow performance in early lactation.

PROGRESS:

Three isonitrogenous (20% crude protein, as fed) isocaloric (estimated 3.3 Mcal digestible energy/kg, as fed) concentrates were formulated. Supplemental protein in concentrates was provided by soybean meal (SBM), fishmeal (FM) or fishmeal with 20% replaced by urea (FM-U). Chopped hay (8.2% crude proein, 36.4% acid detergent fibre, 2.07 estimated Mcal digestible energy/kg, all on as fed basis) was fed free choice. Concentrates were fed two weeks pre-partum (max. 5 kg/d) and challenge-fed post-partum to 11 wks.

Eighteen cows, either Ayrshire or Holstein, primi- or multi-parous (range in parity 1-7) were allocated to treatment diets. Mean parity of cows assigned to SMB, FM and FM-U was 2, 2.75 and 3.5 respectively. Ten (6 Ayrshire, 4 Holstein), 4 (1 Ayrshire, 3 Holstein) and 4 (2 Ayrshire, 2 Holstein) cows were assigned to SMB, FM and FM-U respectively. Milk yield, and concentrate and hay intakes were measured daily and cows were weighed weekly. Milk samples from each milking were composited by week and analyzed for percent fat,protein and total solids. Blood was sampled weekly (from tail vein); hematocrit and plasma urea nitrogen (PUN) were determined. Weekly means were analyzed for statistical significance using a general linear model.

Breed and parity were unequally represented across tretments but several trends were observed. Cows consumed more SBM (11.2 kg/d) than either FM (10.6 kg/d) or FM-U (9.6 kg/d). However, FM tended to increase milk yield (26.0 vs 24.3 kg/d) and percentage of fat (3.83 vs 3.64) in milk compared to SBM. Cows fed FM-U

tended to produce less milk (23.4 kg) with higher percentage fat (4.02). Cows fed FM or FM-U had significantly lower ($P<.10$) PUN than SBM (5.1 vs 6.5 mM) indicating the undegradable nature of FM in the rumen. Apparently FM provided more post-ruminal amino acids than SBM. Costs of diets were similar. Fishmeal has similar feeding value to SBM in early lactation diets based on grass hay for dairy cows. Addition of urea to diets containing FM may not be warranted.

TITLE: Nitrogen Losses by Burning Lowbush Blueberries

LEADER: L. J. Eaton

OBJECTIVE: To determine the extent of nitrogen losses from lowbush blueberry stands as a result of burning.

PROGRESS:

The average loss of nitrogen from plants and litter at all seven sites was 30.08 kg N/ha. Losses varied from light burns to heavy burns. Losses of nitrogen due to consumption of above ground plant parts ranged from 13.11 kg N/ha with a light burn, 27.63 kg n/ha with a medium burn, to 47.88 kg N/ha with a heavy burn, which removed allmost all the stems above ground.

(PROJECT SUPPORTED BY CANADA/NOVA SCOTIA AGRIFOOD DEVELOPMENT AGREEMENT FUND)

TITLE: Influence of Boron Foliar Spray on Growth and Thiocyanate Content of Golden Ball Turnip

LEADER: H.-Y. Ju

OBJECTIVE: To study the effect of boron foliar spray on growth and thiocyanate content of Golden Ball Turnip.

PROGRESS:

'Golden Ball' turnips were grown hydroponically in a greenhouse (20 +/- 2°C) at the Nova Scotia Agricultural College during August and October. Two week-old seedlings were transplanted to plastic buckets holding 8 l of modified full strength Hoagland's solution in each bucket. Four seedings were grown in each bucket. A low level of boron was kept at 0.1 ppm for two weeks until the size of roots reached about 2 cm in diameter. Then boron was removed from the container. Boron was immediately applied as foliar spray with six different concentrations (0, 011, 1.0, 10.0, 100.0 and 1000.0 ppm) obtained by varying amounts of H_3BO3. This experiment was arranged in a randomized block design with four replications. Turnips were harvested a month after transplanting to the solution which contained no boron. At harvest growth measurements were taken and thicyanate and chlorophyll contents were determined.

Analysis of variance indicated significant differences for each of the growth parameters recorded at harvest except percent DW of roots and in the analyzed constituents.

Turnips receiving 100 - 1000 ppm boron grew progressively and equally vigorous until harvested, while those receiving 0.0 - 10.0 ppm boron were substantially inhibited in growth of top and root but more in roots which showed severe boron deficiencies (Table 1). Thiocyanate contents were higher in plants (top and root) receiving 0.0 - 10.0 ppm as compared to plants receiving 100-1000 ppm (Table 2). Chlorophyll content was higher in tops which received 100 ppm. Low chlorophyll content in plants receiving 0.0-10.0 ppm may be due to lack of boron and in plants receiving 1000 ppm may be due to chlorosis caused by boron toxicity (Table 2).

(PROJECT FUNDED BY NATURAL SCIENCES AND ENGINEERING RESEARCH COUNCIL)

TITLE: Herbicide Screening in barley, soybean and fallow

LEADER: M. G. Sampson

OBJECTIVE: To evaluate various herbicides for broadleaf and grass weed control in barley, soybeans and fallow.

PROGRESS:

1. Broadleaf weed control in soybeans.

Fourteen herbicide treatments were evaluated for broadleaf weed control in soybeans. Pre-emergence applications of the American cyanamid product AC263 499 at 0.14 kg ai/ha provided best control with the only weed escape being cudweed. Hempnettle was controlled by this herbicide and also the Dupont product DPXF 6025 + Agral 90 at 0.02 kg ai/ha + 0.1% v/v.

2. Grass weed control in soybeans.

Twenty-two treatments were evaluated for grass weed control in soybeans. All herbicide treatments provided weed control in excess of 75%. Tank mixes of these grass herbicides with broadleaf herbicides provided a broader spectrum of control. Broadleaf herbicides such as Fomesafen and Bentazon showed phytotoxic effects.

3. Wild oat control in barley.

Fourteen herbicide treatments were evaluated for wild oat control in barley. The standard treatment was diclofop-methyl at 0.7 kg ai/ha. This treatment provided 95% control of wild oats. Most effective control was obtained with flamprop-methyl at 1.0 kg ai/ha. This is a currently registered treatment. The least effective control was obtained with Hoe 033171 + MCPA (0.1 kg ai/ha + 0.56 kg ai/ha). The herbicides difenzoquat, AC 222 293, and Hoe 33171 provided control comparable to the standard registered treatment.

4. Broadleaf weed control in barley.

Seventeen treatments were evaluated for broadleaf weed control in barley. Dicamba + MCPA (DYVEL) at 1.10 kg ai/ha + 0.42 kg ai/ha was used as the standard treatment. The Dupont product, DPX M6316 (HARMONY) at 0.030 kg ai/ha provided the best overall weed control (85%) compared to the standard treatment (75%). Weeds controlled included Canada thistle, perennial thistle, lambs quarters, wormseed mustard, chickweed and hayweed.

5. Quackgrass control in sod.

Nineteen treatments were evaluated for quackgrass control in

sod. The Dow product Haloxyfop-methyl + Canplus 411 at 0.56 kg ai/ha + 1.05 v/v provided the best season long control (71%). The use of ammonium sulfate appeared to enhance the activity of the herbicides at low rates. Due to the weather conditions in June, 1985, there was extensive regrowth.

6. Quackgrass control with graminicides + ammonium sulfate.

The herbicides Haloxyfop-methyl (VERDICT), DPXY 6202 (ASSURE), and Fluazifop-butyl (FUSILADE) were tested at field rates and at reduced rates in combination with ammonium sulfate. In all cases the low rates plus ammonium sulfate provided the same level of control as the full field rates of these herbicides.

TITLE: Biological Control of Perennial Weeds in Nova Scotia

LEADER: M. G. Sampson

OBJECTIVE: To coordinate a biological control program in Nova Scotia

PROGRESS:

A committee consisting of M. G. Sampson (Department of Biology, N. S. A. C.), J. Parker (Horticulture and Biology Branch) and J. P. Thomson (Soils and Crops Branch) was established in 1983 to coordinate a biological control program in Nova Scotia. This work is conducted in cooperation with Dr. P. Harris and Dr. D. Peschken at the Agriculture Canada Research Station, Regina, Saskatchewan.

The following projects are ongoing:

1. Biological control of Senecio jacobaea L. (tansy ragwort). Two insects have been introduced into Nova Scotia for biological control of tansy ragwort. The cinnabar moth (Tyria jacobaeae (L.), established in 1964, has spread throughout all areas of the province where ragwort occurs and is still exerting significant downward pressure on ragwort populations. The moth is gradually adjusting its phenology so that larvae are now present throughout July and most of August. The weed continues to be a problem in pastures where the cinnabar moth has not been able to become established, most likely due to unfavorable environmental conditions. In addition, even though plants are severely defoliated, some plants are able to produce a second bloom and still produce seed. The ragwort flea beetle (Longitarsus jacobeae) (Waterhouse) was introduced in November 1984 and the population has survived the winter. The population will be monitored for establishment, damage and spread.

2. Biological control of Cirsium arvense (L.) Scop. - Canada thistle). The insects Urophora cardui (L.) and Ceutorhynchus litura (F.) were introduced into Nova Scotia in 1984. U. Cardui has been established in five locations in the province and populations are increasing. No appreciable damage has been attributed to this insect as of yet. Damage similar to that caused by C. litura has been noticed at its release site, but the insect has not yet been recovered. This site will be monitored to try and find adults of C. litura. Populations of Canada thistle in several were monitored in 1985 for damage caused by naturally occurring organisms. The most prevalent organisms were the rust Puccinia punctiformis (Str.) Rohl., the mycoplasma aster yellows and Cassida rubiginosa. These organisms, although causing damage, are not considered to cause significant reductions in populations of Canada thistle. However, at one site in Bridgetown, Annapolis County, there was a 50% reduction in population size from July to

August. This may have been due to the severe defoliation caused by C. rubiginosa combined with the effects of P. punctiformis, U. cardui and aster yellows.

3. Biological control of Hypericum perforatus L. (St. John's wort). The Chrysolina beetles (C. hyperici (Forester)) introduced in 1969, have increased and spread throughout most areas of Nova Scotia except for Cape Breton Island. A release of C. hyperici was made in Coxheath, Cape Breton County to establish the insect on the island of Cape Breton. St. John's wort is generally restricted to roadways and in abandoned disturbed areas. However, it is becoming a problem in blueberry fields where insecticide sprays are most likely interfering with the effect of the beetle on the weed. Attempts will be made to introduce the insect Anaitis plagiata in 1986.

4. Biological control of Sonchus arvensis L. (Perennial Sowthistle). Two insects, Cystiphora sonchi and Tephritis dilacerata were introduced in 1984 into Nova Scotia. C. sonchi established very well but the colony was destroyed before the insects could disseminate. This insect was reintroduced in May, 1985, but establishment was poor, most likely due to cool, wet weather conditions which prevailed throughout May and June. T. dilacerata was introduced in September, 2984. The colony successfully overwintered and adult flies were noticed on flower buds in July, 1985. Deformed flower buds with pupae inside were noticed on several plants. No adults had emerged from flower buds as of September 15 and the presence of T. dilacerata could not be confirmed. The population will continue to be monitored for establishment of the insect.

5. Pathogens. In excess of 50 pathogens have been isolated from more than 20 weeds and are currently being evaluated for their potential as mycoherbicides. Several of these are of potential use.

(PROJECT SUPPORTED BY CANADA/NOVA SCOTIA AGRIFOOD DEVELOPMENT AGREEMENT FUND)

TITLE: Biosynthesis of cynnamoyl putrescines and other phenylpropanoids in permeated and immobilized cells of Nictoiana tabacum

LEADER: J. Berlin (GBF, Braunschweig, W. Germany); J. Nowak (N. S. A. C., Truro)

OBJECTIVE: Application of bioreactors in the production of natural compounds by plant cell cultures

PROGRESS:

Plant cell cultures are regarded as a new source for the production of natural compounds. The use of immobilized cells has been recommended; under these conditions cell viability seems to be prolonged and productivity increased. As a model system the formation of cinnamoyl putrescines by immobilized tobacco cells was studied. As these components are stored in vacuoles, cells had to be permeabilized to release them into the medium. The biosynthetic potential as well as the release of products were followed by tracer experiments. Production of cinnamoyl putrescines ceased rather rapidly in permeabilized cells. Phenylalanine was converted to coniferyl alcohol and other lignin precursors - a reaction which did not occur in intact cells. Additionally, due to the destruction of compartmentation, the released cinnamoyl putrescines were mostly oxidized or degraded. The technique seems unsuitable for production of components whose biosynthesis involves more than one pathway and is related to cellular compartmentation.

(FUNDING WAS PROVIDED BY THE ALEXANDER VON HUMBOLDT RESEARCH GRANT) (The research part of this project has been completed in the Institute of Biotechnology, GBF, Braunschweig, W. Germany.)

TITLE: Studies on *in vitro* tuberization of potato

LEADER: J. Nowak

OBJECTIVE: To establish optimal conditions for potato microtuber production

PROGRESS:

Under certain culture conditions nodal cuttings used for in vitro propagation of potato produce small tubers. These so-called microtubers are convenient for storage and transport of germplasm and are thought to be suitable for some types of mechanical planting. Several recipes have been published on initiation and growth of microtubers in vitro. However, the response varies from cultivar to cultivar and there is no universal method available. So far, the research has been mainly focused on the hormonal response, concentration of sucrose in the medium, temperature and photoperiod. In our study we have found that starch added to the medium can initiate in vitro tuberization of potato grown under the standard conditions used for micropropagation. The work might contribute to more basic investigations on the mechanism of tuberization.

(FUNDING WAS PROVIDED UNDER POTATO TECHNOLOGY STUDENTS' PROJECTS)

TITLE: Selection of cold tolerant white clover using in vitro techniques

LEADER: J. Nowak

OBJECTIVES:

1. To develop winter hardy white clover with desirable agronomic characteristics.

2. To study correlation between regeneration ability and cold stress tolerance.

PROGRESS:

Field growth analysis of large-leaved Mediterranean white clover cultivar Ladino and small-leaved, winter hardy British cultivar Kent, has been completed. Ladino, like other high productive Mediterranean cultivars which are perennial in warmer climates, normally has poor winter survival under the climatic conditions of Atlantic Canada. Observation trials with other cultivars and local ecotypes of white clover have already been established and winter survival, early spring growth, and stolon elongation are being evaluated.

In vitro propagation and screening for highly regenerative genotypes among white clover plant populations began in September 1985. At present we have nine cultivars and ecotypes of white clover in tissue culture (large-leaved Mediterranean cv. Ladino; medium-leaved cultivars Huia (New Zealand), Olwen (U. K.), Sonja (Sweden), and Smena (U. S. S. R.); small-leaved cv. Kent white (U. K.) and ecotypes; ML-5-6 (from Saskatoon) and G-18 (New Zealand). Results of in vitro propagation showed considerable genetic variation within each cultivar with regard to plant growth, type of root system, callusing and regeneration ability. Detailed analysis of the root system of in vitro and greenhouse grown plants cv. Kent and Ladino have been completed and similar evaluation will be performed on the other cultivars. The authors expect to find a correlation between winter survival of particular cultivars and the structural variation within their root system.

Callusing and regeneration ability within studied cultivars were also evaluated. The highly regenerative and non-regenerative plant populations are presently being selected and will be subjected to cold stress. Higher survival within the regenerative populations is expected. The organogenic calluses will be exposed to low temperatures and plantlets will be regenerated from the survived material. Cold stress tolerance of the regenerated plantlets will be compared to the mother plants.

Within the in vitro plant population of cv. Huia, a highly regenerative, fast growing, and stress tolerant clone with atypical for white clover leaf morphology, has been selected. Mass multiplication of this clone has been undertaken and its seed progeny will be evaluated for leaf and root morphology, growth pattern and regeneration ability. Productivity, LT_{50} and winter survival of the selected clone will also be determined.

(FINANCIAL ASSISTANCE FROM AGRICULTURE CANADA OPERATING GRANT)

TITLE: Effects of application of sewage sludge to farm lands on the protein, organic matter and heavy metal contents.

LEADER: K. S. MacLean

OBJECTIVE: To determine the protein, organic matter, pH and heavy metal contribution to soils and plant tissue through applications of sewage sludge to farm fields.

PROGRESS:

Farmers in Pictou County in cooperation with the East River Pollution Abatement System of the Pictou County District Planning Commission have been applying sewage sludge to farm land since 1978. Sewage sludge utilization guidelines developed jointly by provincial departments of Agriculture, Environment and Health were followed.

The sludge was applied at a rate of 44.8T/ha (20 T/ac) and consisted of a tertiary stage digested sewage mixed in a 3:1 ratio with sawdust. Limestone was also incorporated in this mixture at a rate of 4/48 T/ha (2 T/ac) to raise the pH before application to the land.

Samples of soil and plant tissue from control (untreated) and sewage sludge treated fields were sampled in 1985 and 1986 and analysed for protein, pH, organic matter, lead, cadmium, chromium, copper, nickel, zinc and mercury. Plant tissue samples consisted of grasses, legumes and vegetable tissue.

Results after one year of a two year study indicate that increased levels occur in both soil and plant tissue on the treated fields.

Soil analysis showed higher levels of cadmium, zinc, copper, nickel, lead and mercury in sludge treated fields while chromium was lower.

Organic matter and pH were also higher in the treated samples.

Plant tissue analysis showed higher levels of cadmium, zinc, copper, chromium and lead for sludge treated fields. Nickel was higher for legume samples but lower in grass samples. Mercury was lower in all plant tissue samples from treated fields. Plant protein was generally higher in the treated samples.

In general although initial results showed increased levels for sludge treated fields, these increases were small and would not appear to be a matter of concern at this time as all levels are below maximum recommendation levels.

* PROJECT SUPPORTED BY CANADA/NOVA SCOTIA AGRIFOOD DEVELOPMENT AGREEMENT FUND.